THE

INDIAN FORESTER.

Vol. IX.] January, 1883. [No. 1.

Translation of 'Aménagement des Forêts.'

PAR M. PUTON *(continued from December No.)*

CHAPTER II. COPPICE.

§ 1. *Coppice, with a complete standing crop.*

THERE is nothing easier to understand than the working scheme of a coppice; I shall, however, enter into some detail on the subject, because simplicity being the most important quality of a working scheme, one prepared for a coppice will serve as a model and guide for those suitable for high forests.

Suppose that 300 acres of forests which we wish to manage as coppice, with a rotation of 20 years, contains

15 acres, ...	1 year old,
15 "	2 years "
15 "	3 " "

and so on, the forest growth of each of these compartments being of a similar character, and those of different ages either following each other in a regular manner so as to form a *regular* forest, or being disposed in an irregular way and arranged without any particular order of succession. The last case, which is seldom met with in coppice, where the fellings are usually made in regular succession, often happens in the case of high forest, and will be better understood if we first explain the working of coppices where the standing crop is arranged in regular succession of ages.

A.—*Working scheme of a coppice where the standing crop is complete and regularly arranged.*

The idea which I have just given of a regular forest must not be understood too literally, for it is probable that if it were necessary to find, in such an example as we have chosen, a succession of compartments of 15 acres each and in regular succession of ages from 1 to 20, such a perfect forest would never in reality be met with.

A forest may be considered 'regular' if the scale of ages be so arranged as to allow of the material corresponding to the chosen exploitability being regularly constituted.

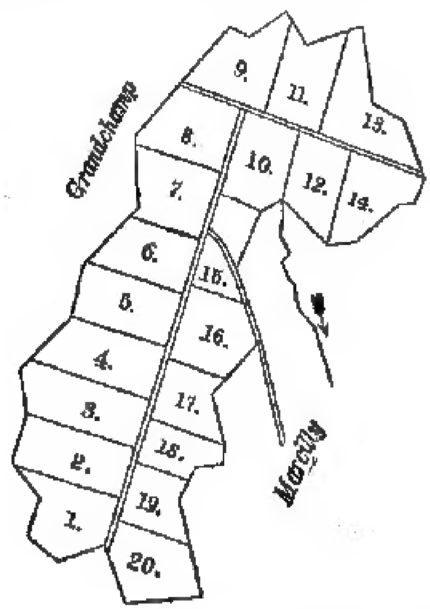
In sylviculture, as in agriculture, there are limits and approximations which we must learn to understand and make allowance for.

General scheme of exploitation.

Let us suppose that the division into compartments, which, in the case of coppice, is most often made according to the lines of former workings, has given us—

				Age.
Compt.	A.	30	acres coppice, oak and hornbeam,	20 years.
„	B.	15	„ „ „ „	17 „
„	C.	45	„ „ oak alone, ...	15 „
„	D.	45	„ „ „ „ „ ...	12 „
„	E.	15	„ „ oak, beech and birch,	11 „
„	F.	30	„ „ „ „ „	9 „
„	G.	60	„young„ beech and hornbeam,	6 „
„	H.	15	„ „ „ „ alder, ...	4 „
„	I.	45	„ plantation oak and hornbeam,	3 „
		300	„	

We shall divide the 300 acres into 20 fellings of 15 acres each,



Arrangement of fellings in a coppice wood.

following each other in regular order, so that each felling will be allotted to a particular year of the rotation. It is generally admitted that coppice fellings of equal area yield equal products. It is not of much use to attempt to form fellings with areas proportional to the fertility of the soil, for it is very difficult to estimate the latter at all exactly. If in spite of this difficulty we should determine to make the areas proportional to the fertility of the soil, it would often happen that after one rotation the conditions of fertility might alter so as to make it necessary to start a fresh division into fellings, and again to survey, demarcate, and clear the lines. The simplest measures are always the best, and if it should happen that a precipice or a blank space unsuited for forest growth be met with, there is nothing to prevent us from adding a sufficient area to the particular felling in which it occurs.

The working scheme, which old foresters used to call the 'arrangement' or 'constitution of regulated fellings,' is so simple for coppices, that one is generally contented with drawing up a map bearing the numbers of the fellings without troubling oneself to trace on it the boundaries of the compartments which have served for the description of the forest.

To the map is added a tabular statement showing the fellings, and their contents, and this table forms the working plan, so that supposing the scheme to have been made in 1881, it would be drawn up as follows (*see* page 4) :—

This is all the mechanism of a working scheme of a coppice; but, in order thoroughly to explain working schemes for high forest, and to assure for them simplicity, which is the chief point in favor of coppice working schemes, we must enter into detail to a certain extent.

Register of the Working Scheme.

The working scheme would be completed if it were not a most useful thing to prescribe certain measures for regulating the procedure of carrying it out. In the exploitation of a forest, as in every kind of business, either agricultural or industrial, it is undoubtedly most useful to prescribe that a register should be kept up. No doubt there will always be books for the pay of workmen and the sale of produce, but I do not refer to these, but rather I wish to treat of the 'capital account.' For some years back the keeping of accounts has enabled agriculturists to regulate and control their business, and all authors who have written on the subject, have especially insisted on a *capital land account*. In an agricultural business the capital account is altered by works for the repair of buildings, the wear and tear of tools, the loss of live stock, &c., and if an exact account were not kept, the cultivator would never know what

General Scheme of Working (1881-1900).

Number of felling.	Name of compartment.	Area of felling.	Area of compartment.	Age in 1881.	Year in which cutting will take place.	Age at time of cutting.	Remarks.
1	A	15	30	20	1881	20	
2		15			1882	21	
3	B	15	15	17	1883	19	
4	C	15	45	15	1884	18	
5		15			1885	19	
6		15			1886	20	
7	D	15	45	12	1887	18	
8		15			1888	19	
9		15			1889	20	
10	E	15	15	11	1890	20	
11	F	15	30	9	1891	19	
12		15			1892	20	
13	G	15	60	6	1893	18	
14		15			1894	19	
15		15			1895	20	
16		15			1896	21	
17	H	15	15	4	1897	20	
18	I	15	45	3	1898	20	
19		15			1899	21	
20		15			1900	22	
	Total	300	300				

his profits were, so that it is even necessary to draw yearly a certain amount from the profits in order to maintain the capital at a real marketable value. What I have said regarding the *working material of a forest will sufficiently explain that nothing* similar takes place in sylviculture; the working material is not exposed to similar causes of depreciation, and there is no necessity for such complicated accounts. The control register of a working scheme need only show therefore one thing, viz., whether at any given time the capital has not been touched. There is nothing so simple as a forest capital account.

There is no need to try and make it a register for the verification of the procedure of valuation, nor a record of administrative measures, nor a register of the rise and fall of market rates: these items of information, all useful, can be relegated to supplementary works like those in which the accounts of salaries, works, and sales are recorded. If we desired to note all this information in a working register, we should only succeed in

constructing complicated tables with a formidable multiplicity of columns which would in truth only confuse us. The character of a good system of accounts is to be very simple and to have a definite object. It is necessary for the proprietor or auditor to know at any time if the working scheme has been followed, and in what way it has been applied, and it is very requisite when important forests have to be worked that the register must be simple, in order to secure its object.

The control of the Working Scheme.

It is not often kept up for coppices, though it would be advisable to have this done, for we are liable to forget the time when the first felling was made, and we should often like to anticipate or postpone the fellings according to the state of our finances, so that after a few years we may not become quite ignorant of the real state of things. I shall presently supply the form most suitable for the register, which is nothing but a succession of ruled pages with headings for the auxiliary accounts of the scheme, but I must first say a few words about a very advantageous practice which is eminently suited to forest working, and especially so when the forests are the property of private persons or of communities.

The Reserve.

One of the rules which ordinary prudence dictates, is not to spend the whole of one's income every year. Unforeseen wants and other demands should compel every man of property to set aside a reserve fund. In industrial business, or in agriculture, this can only be done by investing every year some portion of the receipts, and usually these investments take the form of a new business whether industrial or agricultural, but whatever they may be, they require great care and consideration. In the case of forest property, proprietors have only to leave standing a part of their revenue, and Nature itself takes the responsibility of managing a reserve which thus enjoys the greatest stability and the advantage of producing its own interest. There are two methods by which this reserve stock may be formed.

1st. A definitely located Reserve.

The first method consists in separating off on the ground the number of acres which we have agreed to keep for unforeseen requirements, estimated at 10, 20 or 25 per cent. of the whole forest, according as we wish to reserve 10, 20 or 25 of the whole produce. If we allow, as is done in communal forests, one-fourth of the area for the reserve, we shall have only, in the forest which we have adopted as an example, 225 acres for the annual fellings, which will therefore only allow of one cutting yearly an area of 11¼ acres, leaving 75 acres as a reserve. The register of the working scheme will then be kept in the following manner :—

Felling No.	1	2	3	4	5	6	7	&c.	Total.	Reserve.	Remarks.
Area.	11¼	11¼	11¼	11¼	11¼	11¼	11¼	&c.	225	75	
1881, ...	11¼								11¼		
1882, ...		11¼							11¼		
1883, ...			11¼	5⅝					16⅞	5	
1884, ...				5⅝					5⅝		
1885, ...					11¼				11¼	10	
1886, ...						11¼			11¼		
&c.											

The form shows that in 1883, the proprietor worked one felling and-a-half as well as 5 acres in the reserve ; in 1884 he only worked half a felling, and so thus resumed the working scheme ; while in 1885 he again cut into the reserve and sold 10 acres without altering the regular arrangement of the working scheme.

2nd. A moveable Reserve.

After having divided the 300 acres into 20 fellings of 15 acres each, the application of this method arranges for only clearing three-fourths of the yearly felling, or 11¼ acres, so that one-fourth of each piece, or 3¾ acres, is left untouched every year.

In this way, the reserve consists—

At the end of 2 years of 7½ acres.
" " 3 " 11¼ "
" " 4 " 15 " and so on.

It is not usual to allow more than 4 years' accumulation of reserve, and there are then two ways of proceeding—

1st.—If we wish to make the fellings of reserve of the same area as ordinary fellings, a procedure which is often useful in communal forests—it is convenient to cut the reserve every three years, and to arrange that each group of three fellings shall give four sections which will be worked in three years, the three first sections being the yearly fellings and the reserve constituting the fourth.

2nd.—If we desire to give more importance to the produce of the reserve, it is sufficient to realize every fourth year. In that year then the ordinary felling will be 11¼ acres, and there will also be a full felling of 15 acres in the reserve—this latter being really the piece set apart for the year. Every four years, by an easy surveying operation, a group of three fellings is divided into four sections, which each represent the yearly produce leaving out the reserve. One of these sections is worked

yearly. During the first three years, and in the fourth year we shall work at once both the fourth section and the whole felling immediately succeeding it, and which forms the reserve.

The register of the working scheme for the forest which we have chosen as a type will under the last hypothesis be kept as in the following table, in which care must be taken to enter the fellings of the reserve :—

Felling.	1	2	3	4	5	6	7	8	&c.	Total.	Reserve.	Remarks.
Area.	A 15	A 15	A 15	A 15	A 15	A 15	A 15	A 15	&c.	A 300	¼ of the annual felling = 3¾ A, or 15 A every 4 years.	
1881,	11¼									11¼		
1882,	3¾	7½								11¼		
1883,		7½	3¾							11¼		
1884,			11¼	15						26¼	15	
1885,					11¼					11¼		
1886,					3¾	7½				11¼		
1887,						7½	3¾			11¼		
1888,							11¼	15		26¼	15	
&c.												

The register shews that in 1882 the ordinary felling consisted of 3¾ acres of No. 1 completed by 7½ A of No. 2 ; that in 1883 it consisted of 7½ A of No. 2 supplemented by 3¾ A of No. 3 ; while in 1884 the rest of No. 3 furnished the ordinary felling, and No. 4, as a whole, the reserve felling.

This method of moveable reserve has the advantage of always giving forest fit to cut for the reserve felling, while in the case of a reserve definitely located it is necessary to wait after each felling until it has become sufficiently mature. It is in every sense the best for high forest, but in coppice where the slightest difference in age affects the produce, it involves the inconvenience of making the reserve available only every fourth year. If the felling is postponed, or if it is made too early ; if the proprietor, anxious to take advantage of a year when wood is dear, desires to cut a year or two earlier, the speedy result will be to change the exploitability of the coppice and confuse the gradation of ages, and involve the proprietor in future difficulties. Moreover, in communal forests of broad-leaved trees, which are most frequently worked as coppice, the reserve is fixed at one-fourth of the standing crop by a special order of the Code of 1827, and is always formed by reserving a fourth of the area, although the law is silent as to the method of locating it.

In order to avoid the partial surveys which the above method of moveable reserve involves, the number of fellings is sometimes increased by a third in order to leave one-fourth of the forest area as a reserve. Instead of twenty fellings of 15 acres each, twenty-six fellings of 11½ acres each are marked out on the ground; the six fellings of the reserve can then be located together in a selected part of the forest, or intercalated with the twenty ordinary fellings.

It will be readily understood that this is nothing more than a definitely located reserve, which has, however, certain advantages, and is made on the supposition that the proprietor will not change the proportion of the reserve to the whole forest area, and this is the case with communes where the proportion of the reserve is fixed once for all by the law.

B.—*Working scheme for a Coppice where the standing crop is complete, but irregularly arranged.*

There is little to be said about coppices where the standing crop is not arranged in proper gradation of ages.

As far as productiveness is concerned it matters little whether or not ,the gradation of the ages follow in regular order on the ground, provided that the rules relating to shelter for young shoots, &c., have been observed. But as regards facility for management, for sale of forest produce, and for many other reasons, it is highly advantageous gradually to restore regularity to the coppice. Provided the ground be well stocked, we must not refrain from felling the crop on certain areas even before maturity, in order to bring them to their proper place in the order of future fellings. The temporary loss of produce involved will be compensated by the cuttings on areas where the growth has exceeded the age fixed for exploitability.

The working scheme, then in the most marked manner, assumes its proper two *fold* character, which may be described as follows :—

1st.—To determine the order of fellings for the actual rotation.

2nd.—To prepare for future rotations a crop which shall be fully stocked, regular, and conveniently arranged.

§ 2. *Overstocked Coppices.*

When the crop in a coppice is overstocked, that is to say, too great for the exploitability which has been selected, the table of fellings is arranged so that twice during the rotation, we can work those fellings, or portions of fellings, which are overstocked.

The general working scheme will then show two kinds of produce.

1. The produce resulting from the ordinary fellings.
2. The produce obtained independently of the ordinary fellings, and with the object of making them regular. Suppose, for instance, that compartment (I) of 45 acres should be 22 years old at the beginning of the rotation, we can then exploit it at the first, second, and third fellings, and reserve compartment (A) for the fourth and fifth fellings, but this would involve our working certain fellings at ages of 25 and 26 years, and since the proprietor has chosen 20 years as the best period of exploitability, it would be more useful to work these 45 acres at the commencement of the rotation, and then again at its close.

The tabular statement (*see* page 10) of fellings, to which is usually appended a summary of the works to be carried out, will then be as follows :—

§ 3. *Insufficiently stocked Coppice.*

When the standing crop of a coppice is not sufficient for the chosen exploitability, the designer of a working scheme must prescribe rest, and should endeavour to make this as little onerous as possible for the proprietor.

Supposing that the inventory of the forest should be as follows :—

Compt.	A. 60	acres,	oak and softwoods,	age 14	years.
"	B. 45	"	" "	" 12	"
"	C. 60	"	oak and hornbeam,	" 3	"
"	D. 60	"	" "	" 4	"
"	E. 15	"	" "	" 2	"
"	F. 60	"	blanks to be replanted.		
	Total 300 acres.				

It is evident from the above that we must wait 6 years before we have wood 20 years old for felling. This period of 6 years, which is the interval separating the age of the oldest growth from that chosen as the period of exploitability, has been called the *period of rest*, or the *period of transition*.

Generally the name of *period of rest* has been applied to the time required for regulating the fellings in a forest fully stocked, but without proper succession of ages, or for removing the

excess material in an overstocked coppice ; or lastly, for the case now under consideration. There are two modes of procedure.

Tabular Statement of Fellings (1881 to 1890).

No. of fellings.	Areas.	Age of standing crop in 1881.	Year for felling.	Age of standing crop at time of felling.
	§ 1. *Extraordinary produce.*			
	Acres.			
18	14¾	22	1881	22
19	15⅛	22	1881	22
20	15⅛	22	1881	22
	§ 2. *Ordinary produce.*			
1	15	20	1881	20
2	15	20	1882	21
3	15	17	1883	20
4	14¼	15	1884	19
5	15¼	15	1885	20
6	15¼	15	1886	21
7	15⅜	12	1887	19
8	14⅝	12	1888	20
9	15	12-11	1889	20-21
10	15	11	1890	21
11	15¼	9	1891	20
12	14¾	9	1892	21
13	15	6	1893	19
14	15⅜	6	1894	20
15	14⅞	6	1895	21
16	15	6	1896	22
17	15	4	1897	21
18	14¾	1	1898	19
19	15⅛	1	1899	20
20	15⅛	1	1900	21
	300			

Remarks.

Area of fellings during the

Rotation	...	345	acres.
Ordinary fellings	...	300	„
Excess	...	45	„

The area has been sub-divided as follows :—

1. Ordinary fellings (11¼ acres)	225	acres.
2. Moveable reserve	75	„
3. Extraordinary fellings	45	„
Total ...	345	„

General description of works to be undertaken—25 acres in fellings Nos. 2, 4, 7 to be drained ; 2½ acres to be planted up in No. 8, in the year 1887, or thereabouts.

The export road to be widened by a breadth of 12 feet.

The first is at once to mark off the fellings for each of the 20 years of the rotation whilst prescribing the 6 years of rest (Final working scheme).

The second method is to fix the fellings which can be made

in the period of rest, and to put off the working scheme till after its expiration (Provisionary working scheme).

The latter method has been for the most part abandoned, and it is only in the rarest, and most exceptional cases that provisional working schemes are made—there are many reasons for this—

1st.—In the actual condition of our forests, none of which is theoretically regular, the first rotation will always have a more or less transitory character. Why then make a distinction between transitory and definite working schemes?

2nd.—It is evident that the work of estimating the standing crop, and surveying the forest area is necessary before we can be certain that the forest is over- or understocked. There will, therefore, be no more trouble in proceeding at once to draw up the working scheme, and it would be very bad management to do all this work over again at the end of the period of rest.

3rd.—A working scheme does not only prescribe the order of fellings for the standing crop, but besides this it has for its object to prepare a stock which will form the material for future rotations.

It is, therefore, always of the greatest advantage to draw up the general working scheme once for all. And, moreover, in this particular case, where the standing crop is scanty in places, and a period of rest will be necessary, it is always an advantage to prescribe at once the location of the fellings, for it will generally be possible to lighten the burden of the period of rest for the proprietor, by giving him produce gleaned from all parts of the forest.

If certain blocks will yield mature trees, whilst others require to be felled before the period of their exploitability, in order to make them take to their proper rank in the age gradation, it will be useful and productive to work out these products during the period of rest.

In working schemes for coppice, the necessity for a final arrangement of the fellings has never been called in question; and it is only in high forests that provisional schemes have been sometimes employed. If I mention the subject at all, in this place, it is because the simplicity of coppice management will the better impress on our minds the reasons for dispensing with such schemes.

The tabular statement of fellings for the preceding case will be prepared as follows by allotting halfa felling to each of the six earlier years of the rotation :—

No. of the fellings.	Areas.	Age of standing crops in 1881.	Year for felling.	Age of standing crop at time of felling.	Remarks.
1	15	14	1881-86	14-15	Works to be undertaken—
2	15	14	⅕ felling	16-17	Planting No. 17, 15 acres in 1881.
3	15	14	per annum.	18-19	18, 15 " 1882.
4	15	14	1887	20	19, 15 " 1883.
5	15	12	1888	19	20, 15 " 1884.
6	15	12	1889	20	Total, 60 acres.
7	15	12	1890	21	
8	15	8	1891	18	
9	15	8	1892	19	
10	15	8	1893	20	
11	15	8	1894	21	
12	15	4	1895	18	
13	15	4	1896	19	
14	15	4	1897	20	
15	15	4	1898	21	
16	15	2	1899	20	
17	15	..	1900	19	
18	15	..	1901	20	
19	15	..	1902	20	
20	15	..	1903	20	

CRITICISMS ON "NOTES FOR A MANUAL OF INDIAN SYLVICULTURE."

My replies to "Sw.'s" remarks, printed in the December Number of Volume VIII., must, for reasons which need not be mentioned, be deferred until the next issue of the "Indian Forester."

MR. HEARLE.

I have since received some very valuable criticism from Mr. Hearle.

Discussion being invited, I wish to offer a few remarks on the portion which appeared in the "Indian Forester" *for October 1882.*

As a rule the scientific names of plants are given, save in the two following cases:—1st, when there is a well-known English name, and here the omission seems justifiable; and 2nd, when there is a well-known Vernacular name, and in this case the addition of the scientific name would, I think, be an improvement.

It is stated that the MANUAL *is intended for all territories under*

the jurisdiction of the Viceroy of India. Now in these territories vernacular names change from one province to another, often from one district to the next, and two or three distinct species frequently bear the same name, e. g., "khair." On turning to the "Forest Flora of the North-West and Central India" two species are found bearing this name, Mimosa rubicaulis *and* Acacia Catechu; *so that a slight doubt might exist as to which species was intended, were it not for the fact that the former is a shrub, whilst the one mentioned in the* MANUAL *is classed as a small tree. A Forest Officer in Burmah, however, possessing the "Forest Flora of British Burmah" by Kurz, which gives no Hindustani names, would probably, if he had seen no service in India, not be aware that "khair" was his old familiar acquaintance "Sha bea;" whereas he would have had no difficulty, if the Latin name,* Acacia Catechu, *had accompanied it.*

Mr. Hearle's remarks are very just. I was under the impression that the word *khair* could be considered as the English (Anglo-Indian) name for *Acacia Catechu*, just as *teak* is now universally accepted as the English name for *Tectona grandis*, and *sál* as that for *Shorea robusta*. Be it remembered that the Persian name for teak is *sal*, and that in the Central Provinces the name *sál* for *Shorea robusta* is unknown to the natives. To be logical, Mr. Hearle should, therefore, insist on my giving the scientific nomenclature also after the names *teak* and *sál*.

This he will not, I feel sure, permit me to do. Will he not then allow the name *khair* to stand by itself?

The term "social" as applied to teak, Dalbergia latifolia, Adina cordifolia, *&c., is I think a bad one, because it is used in a directly opposite sense in other branches of Natural History. For instance,* Loxia socialis *of Southern Africa is called the* Sociable Weaver Bird, *because several hundreds of them live together and form a nest in common. For the same reason, bees, wasps, and ants amongst insects are called* social, *because many of the same species live together. By the sea-shore pools are found containing crabs, shrimps, fish, anemones, sponges, &c., mixed up together, but these various species of animals are not called social on this account. If the term be used, I am of opinion that it should be applied to gregarious trees, like* Pinus longifolia, *rather than to the other class.*

The meaning given to the word "social" by naturalists was present to my mind when the DEFINITIONS were drawn up. I had already characterised gregarious trees as *exclusive*, since their tendency is to *exclude other species from growing in company with themselves*. What term was I to adopt for the opposite of "exclusive"? As regards human beings it is *social* or *sociable*. Although the adoption of the first of these two latter terms was contrary to received usage among scientific men, yet for some

reason, which it would be too long to explain, I preferred that term to the other. Mr. Trimen also finds fault with me, and suggests the terms "scattered" or "sporadic" instead. The use of "scattered" would be awkward. "Sporadic" would certainly be applicable to the class of trees in question, but it would not imply the idea that I have endeavoured to bring out, viz., of *tolerating the presence of other species*. Will not "sociable" do? Its employment would involve no violation of current usage.

The terms "exploit," "exploitation" and "régime" are rather foreign to the English tongue. Could not the more simple words "work," "working" and "system" be used in their stead?

I have already answered this objection, successfully I hope, in the number of December last.

Whilst discussing the "Greater suitability of Soil and Subsoil" *at page* 113, *it is stated that* "the eng (*Dipterocarpus tuberculatus*) will drive out all other species from laterite in Burmah." *This statement is, I think, rather too broad, as it implies that pure eng forests are to be found on all laterite formations in the Province mentioned, which is not the case, the eng being accompanied by numerous other species, such as* Xylia dolabriformis, Terminalia tomentella, T. alata, Careya arborea, Adina cordifolia, *and many others, so that it is frequently not even the predominating species.*

I am very much obliged to Mr. Hearle for this correction.

At page 114, *it is stated that* "in the Himalayas *Quercus incana, dilatata* and *semecarpifolia* can never rise above a mere bush where grazing is unrestricted." *This is, perhaps, one of the reasons why we so often find patches of pure deodar near villages, the broad-leaved species being kept down by the sheep and goats of the villagers.*

I will not fail to insert this very valuable remark of Mr. Hearle's in the Notes. The broad-leaved species being kept down in the form of bushes, the tender shoots of which are lopped off or browsed down as soon as they make their appearance, they cannot obviously seed, and are hence unable to reproduce themselves except by means of seed transported from a distance by wind, &c. As the soil is trodden down hard by the cattle, very few such seeds can germinate; and of the few seedlings that do come up, the majority must inevitably be browsed off or otherwise perish almost as soon as they make their appearance.

With regard to climbers, I imagine they are selective in this sense that they prefer rough-barked trees to smooth ones, such as Homalium tomentosum, *the epiderm of which peels off in large thin scales after the manner of* Platanus orientalis. *On such trees climbers are rarely observed.*

This remark is very interesting. Does it agree with the experience of other observers? We can understand that climbers, which ascend by merely scrambling up or by means of tendrils or hooks, will find considerable difficulty in getting up into trees with a smooth bark that is constantly flaking off. But surely in the case of twiners it will not matter at all whether the supports up which they are climbing have smooth or rough bark, or whether the bark peels off or not. Will gentlemen, in whose forests *Terminalia Arjuna* is abundant, kindly inform readers of the "Indian Forester" whether this species is often troubled with climbers, and also state their mode of ascension? *Boswellia thurifera* and *Sterculia urens* have also a smooth bark that is constantly falling of in thin plates, but it is the soil in which these species grow which, as a rule, guarantees them against the attacks of climbers.

According to the definition of the term "climber," the vanilla plant is one, although belonging to the Orchid family, which are chiefly epiphytic or small terrestrial plants. But if the vanilla be a climber, then it forms an exception to the rule that climbers can bear a large amount of shade, as to flourish it requires direct sunlight for a portion of the day, and will not grow in a dense mango grove, although it flourishes on isolated trees of that species in suitable localities.

I have had no experience of vanilla cultivation. But Mr. Hearle himself acknowledges that the vanilla plant is sufficiently shade-bearing to be able to flourish on a mango tree in suitable localities. Now a tree that can grow with even a portion of its crown inside that of another is certainly one that "can bear a large amount of shade."

I think a seventh might be added with advantageto the six subheads given under "seeding," and under it I would treat of the liability of seeds to be attacked by men and other animals. Thus many kinds of nuts, the seeds of Pinus Gerardiana, *&c., are collected for food;* other *kinds, such as* Cassia Fistula, *for medicine; others again, as* Sapindus detergens *for industrial purposes. Then animals such as squirrels, mice and birds, devour a large number of nuts and pine seeds; mice indeed often destroy the hopes of the nurseryman and cause him to postpone his sowings until the seed is about to germinate.*

Insects are frequently very destructive. This year, I wished to collect a small quantity of kakkar (Pistacia integerrima) *seed. It flowered abundantly in May, and in September numerous seed panicles were to be seen; but on examination, in every drupe was found the larva of a weevil, and although a large number were examined, not a solitary sound seed could be obtained.*

I will adopt this seventh sub-head as suggested by Mr. Hearle, whom I heartily thank for pointing out the omission, and for the extremely valuable information he has supplied. The omission in question had struck me also, but in the hurry of sending the manuscript to press, I forgot to supply it.

The struggle for existence is most interesting, and I look forward with pleasure for the appearance of the next part.

Mr. Henry Trimen.

Mr. Trimen, of the Royal Botanical Gardens, Peradenia, Ceylon, has very kindly afforded me the benefit of his advice.

I have just been reading rapidly through the "Notes for a Manual of Indian Sylviculture" printed in your October Number. As you recognise the desirability of criticism before these obtain a permanent publication, I think it well to suggest alteration of a few terms.

1. *There is no gain in giving the stem of a palm a distinct name, nor any reason for restricting the term* caudex *in the manner suggested.*

Everything considered, I agree with Mr. Trimen. Palms are not of much importance to the forester. The definition will be struck out.

2. Epicorm *is a new word, and not a happy one. Why not speak of* stem-shoots?

The stem of a tree does not necessarily mean the portion of it below the branches. Hence, a stem-shoot may be situated anywhere in the interior of the crown. The class of shoots I have attempted to define are those that develop on the clear stem under the branches, when this is suddenly exposed to sunligut after having been surrounded for a more or less considerable time by close standing growth. These shoots originate from dormant buds, and are what are termed *branches gourmandes* in French, and *Wasserloden* or-*reisen* in German. If we admit that the term *bole* denotes the portion above ground of a tree below its branches, we may employ the expression *bole-shoot* instead of *epicorm*, but I, for my part, certainly prefer the latter.

3. *"Broad-leaved" as a general name for dicotyledonous trees is as misleading as to state that all conifers "bear needles."* Podocarpus *(there is one Indian species) and* Dammara *among the latter have very much broader leaves than numerous angiospermous trees.* Casuarina *has no leaves at all, and is very like* Ephedra *in that respect, yet one is angiospermous, the other gymnospermous.*

I am very much indebted to Mr. Trimen for reminding me that I have omitted the exceptional cases which he specifies.

This omission makes the definition misleading. In future the definition in question will be worded as follows:—

"Dicotyledonous trees, as distinguished *in a general manner* from the Coniferæ, may be termed BROAD-LEAVED trees. We say '*in a general manner*' advisedly, because two unimportant coniferous genera *Dammara* and *Podocarpus* have more or less broad leaves, whil some dicotyledonous trees, like *Casuarina*, produce no leaves at all, or, like the Tamarisks, possess only scale-like or inconspicuous leaves."

4. *The term "social" is employed at page 102 in a precisely opposite sense to that in which botanists are accustomed to use it. It is usually considered synonymous with gregarious; and what is here termed "social" would be generally termed "scattered" or "sporadic."*

This objection has already been answered by me on page 13.

5. *In spite of the now established generality of more or less movement in plants, it is scarcely good English to speak of plants as "vivacious" or as "possessing vivacity." Vitality is surely meant.*

Does Mr. Trimen not know that *vivacious* has not unfrequently been used by the best English writers in the sense of *tenacious of life?* Being presumably a botanist, he is doubtless also aware what a vivacious plant is. I fail, therefore, to see any connection at all in his remarks between movements in plants and their tenacity of life. Vitality, which he suggests, is a very good word and has been frequently employed in the Notes: but it has the serious drawback of having no corresponding adjective like *vivacious*.

6. *I am not competent to advise on the technical terms of pure forestry, but probably a better word than "canopied" (which suggests an upholsterer's catalogue) might be found for dense unbroken forest.*

I shall be very glad indeed to have a better term than "canopied" with equivalents for all the derivatives of that word, which follow in the next definition. Because we have no single word at present for what the Germans call *Bestand* and the French *massif*, that is no reason for not inventing one. *Covert* would not be a bad word, but by no means so good as the term I have already proposed for adoption. Mr. Trimen's remark about the suggestion of an upholster's catalogue is quiet beside the point. The term *subulate* for a certain shape of leaf reminds one of the carpenter's or cobler's trade, while the word "hair" carries one's ideas away to a barber's shop. But such puerile considerations will obviously not prevent Mr. Trimen himself as a

botanist from using those two words whenever the necessity arises.

E. E. FERNANDEZ.

A JOURNEY THROUGH CHAMBA,

(Continued).

My next trip was to Debi Koti, a village to the north-east of Tisa on the road to the Cheni pass which leads into Pangi. This is a very pretty march for the first half, and the path is very easy for walking, and can even be ridden for the greater part; but it is so glorious to be able to walk all day long that I have altogether given up the idea of riding at all. The path goes on the level for a good way, through some very pretty forest scenery down to the Baira nullah, which is a mere chasm like the one at Tisa, of which it is a tributary. There is a bridge over it on the way to Debi Koti, which is not more than 18 or 20 feet wide, and it is certainly well over 200 feet to the water, as we ascertained by dropping a stone. After crossing this our troubles began, for we had a very nasty walk up a path, very steep all the way and in the blazing sun, which we felt very much indeed, and I gradually got rid of coat and waistcoat, &c., until I had very little on to speak of, still the blaze was too much for me, and I got a violent headache which spoilt my pleasure for the day. There is a nice little forest near the village, nearly pure deodar, and it is evident that the land was once under cultivation, as it is composed of terraces built up in the usual way. It was probably abandoned ages ago, and there being a few seed bearers left, they have gradually turned it into a forest again; but it must have been very long ago, as not even the "oldest inhabitant" had any tradition even of its once being cultivated land; it only shows how completely deodar will reproduce itself from seed under favorable circumstances. We counted some rings on stumps, and found the average number per inch to be 8 or 9; we also cut a sapling of 7 inches girth close to the ground, much oppressed by large trees, and found 36 rings, whereas one hardly any larger in girth, but growing in the open, had only 25 rings. On the way to Debi Koti the only noticeable ferns were *Gymnogramme toota*, and *Gymnogramme Levingii*, the latter is so very like *Polypodium distans* that I may possibly be mistaken. On the range above Debi Koti I found some small plants of *Cheilanthes subvillosa*. Next day we went to see the place where poor Pengelly was killed on the 29th July, 1880. We only looked at it from the opposite side of the nullah, not having time to cross, but from where we were, could see quite plainly how it happened. It would seem that he wounded a black bear in a tree near the village of Chandru higher up, and followed it down to its cave, and against the advice of all

with him, took the lower of two paths; had he gone by the upper he could have shot it in safety, as it was he had to go by a narrow ledge which ran along the top of the precipice in front of the cave; he reached the cave and stood before the mouth of it, his little dog ran in, was killed by the bear, which presently rushed out, and whether accidentally or not, can never be known, knocked poor Pengelly off his feet, and he fell over backwards a depth of certainly 200 feet sheer, upon the boulders at the side of the stream below. It was a very sad affair altogether, the more so as those who have been to the actual place tell me that had he gone by the upper path he could have stood above the cave and shot the bear from a few feet distance in perfect security. I suppose he lost his head like many a good man before him.

Next day we returned to Tisa. It was a very different matter going down the hill, it seemed a mere nothing. Our next march was towards the Bhandal Valley, which starts from the Padri Pass (10,000 feet) on the boundary of Cashmere, and continues to Manjir on the Siul river. Our road, a steep path as usual, lay down the Tisa spur to the crossing of the Chandrés, a tributary of the Tisa nullah. Close above the junction of the two nullahs is a remarkable chasm, called "Jahannam" by the natives. It is formed by the river rushing between two cliffs, which it has in ages past hollowed out to its present depth. The height from the top of the bank to the water is between 300 and 400 feet, and it does not appear to be more than 15 feet wide anywhere. Our sleepers (10 feet long) often get jammed here, to the number of 500 or more, and men have to be let down by ropes to clear the jam. I doubt if anything can be done to improve the place for floating purposes. Blasting on a large scale might bring down the hill side, and on a small scale would be of no use. The march (to Himgiri) was not an interesting one. From the Chandrés bridge there is an exceedingly steep and bad path for some distance, and then it gradually ascends through fields and over bare hill sides to the village of Himgiri. Of ferns I noticed a great deal of *Cheilanthes Szovitsii* (or *fragrans*) in the walls of the fields and also *Pellæa nitidula*, but no others worth taking. The encamping ground at Himgiri is a very pretty one, being a nice grassy flat with some fine hill mulberry trees at the sides; it is just above the Raja's koti and commands a fine view of the whole country round, but at the same time I should not care to be encamped here in a storm. The koti is built on a prominent point of the spur, and from a distance looks not unlike some old Baron's castle.

7th July. To Diur—about 8 miles—a very nice march, alternately in sun and shade. At first the road was fairly level, and then descended pretty sharply to a stream, and almost as sharply up the other side of the valley. We passed through the Gamhir forest, a very pretty little mixed forest of pines and oak, &c.

On the top of the ridge, near a "Devi," were some of the finest deodar we have yet seen. We measured five fine straight trees, and found them to range between 15 feet and 18 feet in girth at 4 feet above ground level. The encamping ground at Dnur is a very good one, well below the village and with lots of room for tents, which is not always the case in these hills. There are a few deodar trees near it, and at one side a really enormous "kakkusin" (*Rhus punjabensis*); the spread of the branches was something grand, and the girth of the trunk over 16 feet. Here I first noticed the hawthorn (*Cratægus oxyacantha*) which is occasionally found, generally near villages. I believe it is common in Pangi. Bears are very fond of the fruit, which when ripe is nearly as large as a Morella cherry. We had a very nasty evening to wind up the beautiful day with, very stormy with a high wind, rain, and finally a dense moist fog, so that we could do nothing but grumble; however, as we have been very lucky in the weather hitherto we soon got cheerful again. I have got no ferns since leaving Tisa, all that I have seen being either common ones or varieties of which I have gathered sufficient specimens.

J. C. McDonell.

III. Notes, Queries and Extracts.

THE SPANISH CHESTNUT.

TO THE EDITOR OF THE "INDIAN FORESTER."

DEAR SIR,—I mentioned in a recent number of the "Indian Forester," that the Spanish Chestnut trees growing at Nachar and Kilba in the Upper Sutlej Valley, had not fruited up to the end of 1881. This year, I am glad to say, that one tree at Nachar and three at Kilba ripened from the middle of September to the end of October. 174 nuts, quite equal in size and flavour to those grown in Europe. The flowering and fruiting occurred at the same time as the Horse Chestnut, and I think, there is no doubt that the Spanish or Edible Chestnut *(Castanea vesca)* takes kindly to the soil and climate of this part of the valley, and that its success may now be considered established.

G. G. M.

FOREST TRAMWAYS.

TO THE EDITOR OF THE "INDIAN FORESTER."

SIR,—In looking through an early number of the "Indian Forester," I chanced on a letter written to the Editor signed "D," in which he describes an idea he had for a wooden tramway.

Now a cheap serviceable wooden tramway would be a great boon to us all, so I should like to know if "D.'s" idea has been followed out by himself or any one else, and with what result.

I don't quite understand "D.'s" idea myself, never having seen a slide such as he speaks of. It (his ideal tramway) appears to be two parallel grooves in which the wheels are to run, but I should like to know how the grooves are made, and at what cost. Would there not be considerable friction against the sides of the grooves, especially up hill?

F. B. DICKINSON.

A GIGANTIC CEDRUS DEODARA.—I send you the dimensions of a large *Cedrus Deodara,* which is standing alone on a slope of 25°, in a soil resting on gneiss rock, and about 500 yards to the north-east of Punang village in Bashahr. It is 150 feet in height, and measures 36 feet 4 inches in circumference at the base; measuring 31 feet 6 inches in girth at 6 feet from the

ground. Excepting two sunken knots—which are not disfiguring—the tree has a clean stem of 45 feet in height to the first branch, and is a fine symmetrical specimen, showing no signs of decay. In former times, it was the village target, and hundreds of iron arrow-heads are buried in its bark, and it is said, that a man who had a grown up son, before sending him to serve in the Raja's body-guard at Rampur, tried whether the time was propitious, by shooting an arrow at this tree, and if it stuck, his son was sent; but if it fell to the ground, he was not allowed to go that year.—G. G. M.

COLD WEATHER FLUSH OF LEAVES IN SAL TREES.—A number of measurements are yearly being made regarding the growth of sal, and statements noted during what months of the year this growth is taking place in most of the sál-growing tracts of India. Perhaps it would interest those engaged in recording these facts to know, that this year in November very nearly the whole of the sál along the outer Sewaliks, in the Sahárampur district, is throwing out a vigorous flush of new leaves, lengthening the shoot in cases by four and five leaves. This I believe is quite unusual, and was most certainly not noticed last year. The trees I may mention are still clothed with their old leaves quite fresh and healthy.

It is to be regretted that no measurements have hitherto been taken here, but I am happy to state that the matter is now receiving attention.—L. A. E.

NOTES FROM CYPRUS.—The following extract from a letter from the newly appointed Forest Officer in Cyprus will interest our readers:—

"There has not been a single shower here in the plains since I came; nor, I am told, has there been any rain since February or March last; we daily now expect the rains. The thermometer in the coolest part of my house used to go up to 90° frequently with windows all open—no punkahs here—the nights were always cool—now the weather is delightful. In the west of the Island there are still very fine stretches of pine forest (pure *Pinus maritima*); also a small area of cedar, and on the highest ridges at Troodos, the *Pinus Laricio* is plentiful. But the destruction from overcutting and tapping for resin has been terrible. Madon wrote a very full and able report on the whole forest question of Cyprus—perhaps you have seen it? I was glad to hear that Madon had been given the C.M.G.

"The Government of Cyprus have been and are still very slow in commencing forest conservancy measures; thousands and thousands of goats pasture through the pine forests during the summer months, the consequence is little young forest is to be seen anywhere. The coming year may see the appointment of a permanent commission for delimiting the State forests and taking up reserves.

"The opinion one gets, regarding the climate of Cyprus, are very varied. Some say during 8 months (1st October to 31st May) it is second to no place in the South of France; others again who have been here for several years, say it is by no means healthy in the plains From what I have seen of the climate I much prefer it to our own home weather. Nicosi (the head quarters) is of considerable size, the ramparts round are about three miles, and it is densely populated inside, still almost every house has its little fruit garden, and date trees abound. The supply of excellent water is abundant; just now grapes and figs are in perfection—a plateful of either costs about 1*d.*—also a quart of the native wine (the pure juice of the grape) is about 1*d.* Living is tolerably cheap, but native servants are bad as a rule, and very dear—a fair native cook costs £3 or more per mensem, *plus* feeding!"

FOREST SCHOOL AT COOPER'S HILL.—A friend, at home on furlough, has informed us that nothing definite has yet been settled about the training of the new Forest Students for India, at Cooper's Hill. There is even some talk of the Agricultural College, Cirencester, being preferred, but doubtless after Mr. Brandis has seen the authorities at home, the best scheme possible under the circumstances will be decided on.

It is hinted that the English Foresters are not at all pleased with the Cooper's Hill scheme, as the education there is very costly (£200 a year), and for other reasons which we will not enter on, and that they would prefer Edinburgh as being nearer to the Pine Forests of North Britain. But in these days of rapid communication there is no necessity for the Forest School to be situated close to the more important Forests of Great Britain, though it is always an advantage to have a certain area of forest land in the neighbourhood. Our correspondent suggests that a course of Forestry could be established at Kew, there are splendid gardens, museums, and botany lectures could easily be arranged for, and for other subjects the lectures at the London University would be available. A large part of the practical work would still have to be taught in the German or French Forests, but minor points such as planting, felling, &c., could be shown in England.

In our opinion Cirencester would be the better place, and the Forest of Dean is available in the neighbourhood for practical work, but the decision to be arrived at will require much forethought, and we cannot expect that the authorities at the India Office will have a matured scheme ready before several months have elapsed.

THE SCHOOL OF FORESTRY AT NANCY.—The examination of candidates for the School of Forestry at Nancy, which is attended by so many Englishmen, has just been concluded, and the fifteen successful candidates will commence their course of studies

on Saturday. This school was founded in 1824, but it has been reorganised as many as four times since then, and at the present time there are four regular and four assistant professors, the course of study comprising practical forestry, mathematics, construction and drawing, natural history, law, and German. The students now remain for two years at the school, though, up to 1880, those who were going to be employed in the service of the State, had to remain a third year. A short time ago the State resumed the management of the forests, which had hitherto been used by the School of Forestry for giving practical lessons; but at the same time about seven thousand acres of forest in the neighbourhood of Nancy were placed at the disposal of the directors of the school. The buildings are very spacious and complete, comprising, in addition to the residence of the director and his staff, mineralogical, geological, zoological, and entomological collections, in addition to a collection, which has no parallel in France, of native and exotic woods. There are also a long gallery of models, a chemical laboratory and amphitheatre, and forty rooms for the accommodation of students. Since the foundation, 1258 students have been passed from it into the service of the State, and it has also given a complete or partial education in forestry to twenty free students of French origin, and to 107 foreigners, this latter figure being exclusive of the seventy-four students who have been sent to the school by the English Government, preparatory to their being employed in the Forest Department in India. Since the war with Germany, the new military law renders all the forest officials of France liable to service in the army; but a recent decree has somewhat mitigated the severity of this measure, by providing that they shall be embodied in the forces which are stationed near their place of employment.—*The Field*, 11*th Nov.*, 1882.

We have extracted the following from the *Timber Trades Journal*, and hope that some of our readers may be able to give the necessary information:—

"*East India Ironwood.*

"SIR,—Can you give me any information as to where I can purchase any Ironwood (from India)?—Yours truly,

"SUBSCRIBER."

October 16*th*, 1882.

[We do not know of any wood in the English market known by the name of ironwood imported from India, nor can we hear of any one who has ever seen any in the docks. It is, however, described in Laslett's "Timber and Timber Trees," and Royle's "Descriptive Catalogue of Woods," and other standard works, and is therefore a wood the qualities of which appear to be well known. We are inclined to think that it can only be met with in this country in specimen or sample pieces. If any subscriber has a parcel of this

wood for sale, we shall be happy to put him in communication with our correspondent, who wishes to buy.—Ed. *T. T. J.*]

Public Lands in America.—In a number of the *North American Review* a writer makes the following suggestions on this question in an article headed "Our Public Lands":—

"Much the largest portion of the remaining public domain is, at present a common—herders, wood-cutters, lumbermen, and prospectors *roam over it at will, most of them unable to acquire title under* present laws to what they require for their actual wants and the public benefit. They are trespassers, invited to become such by the laws. The object of the nation should be to fill the public lands with actual settlers or occupants, and to this end the acquisition of title should be made as easy as possible."

After referring at length to the pasturage or grazing lands, he concludes as follows:—

"The timber culture Act should be repealed. The object is a good one, but in practice it is shrouded in mystery. At the expiration of eight years, the Government hears from a person who has filed. He may have done something, or may have done nothing. Nine millions of acres of agricultural lands have been located under it; an additional *quantity of land for timber culture could be added to the* present homestead, or the period of settlement shortened, in like entries, in consideration of planting or growing a specified number of trees. The timber lands, usually containing mineral, and unfit for cultivation when cleared—except a portion in Minnesota, Wisconsin and Michigan—should receive attention. They are now in charge of the General Land Office, aided by a corps of efficient local timber agents who *collect stumpage, and report* waste and trespass. These agents have collected large revenues for the Government. The timber should be sold in alternate sections, the fee to remain in the Government. Nature would replace much of the cut forest, and the sections from which the timber had been removed would be spaces preventing the spread of fire. Millions of acres of the best timber lands have passed, and are now passing, in its private ownership *through perjury under* the Preemption Act, and millions of acres have been stripped of their trees under the filing of a mere declaratory statement, and then abandoned.

"The timber on the public domain is absolutely necessary for the development of the country. Mining would be impossible without it, and settlement as well. The present laws for sale or protection are insufficient. Private ownership will best protect the timber. The amount of *speculative theory on this question is simply overwhelming.* The fact is patent that the timber on the public lands is being destroyed and wasted by fires caused by lightning, friction, by campers, and by trespassers; and the further fact is before us that a large and growing population living near it requires the timber for domestic and commercial uses. If they cannot get it legally, they will get it illegally. They must have it, and existing laws furnish but little *real relief.*"—*T. T. J.*

THE

INDIAN FORESTER.

Vol. IX.] February, 1883. [No. 2.

TRANSLATION OF M. PUTON'S AMÉNAGEMENT DES FORÊTS.

PART II.

CHAPTER II.—*Stored-coppice* management.*

"STORED-coppice," or coppice interspersed with a number of large trees reserved to attain timber dimensions, is a class of forest in which (besides the coppice) the proprietor rears a number of trees destined to stand through two, three, or four rotations of *coppice-cutting.*

The working scheme is arranged exactly as for a simple coppice, only that the capital is more considerable, as it consists of two things:—

(*a*). A series of coppice growth from 1 to 30 years, (for example,) as in a simple coppice.

(*b*). Timber trees, more or less numerous, and more or less regularly distributed over the forest, according to the resources of the proprietor, or his special object in management, and also according to the requirements of the different species as regards their growth. †

---

* *Taillis composé*, or *taillis sous futaie*, means coppice with reserved standard trees. In parts of England such reserves are called "stores" and in the absence of any other neat technical term I always use "stored-coppice" for coppice with such reserves. "Coppice-under-standard" is a phrase rather than a term, nor is it quite correct, for in many cases the coppice is not *under* the standards. "Stored-coppice" is a *term*, and it has the chief requisite for a technical term viz., that it should not convey any meaning except its technical one. A technical term which has a common meaning (and that a wrong one) is always objectionable.—(TR.)

† This of course is a great point. In Changa Manga plantation, the design was to have a coppice of sissu with other species, (but the sissu has suppressed most of the other kinds,) with 40 reserved trees of sissu to the acre. It was found, however, that the sissu cut for coppice declined to re-produce itself under any shade whatever, still less that of 40 trees per acre. Here then the requirements of cultivation have to be consulted as much as the desire of the proprietor. Unless something else can be got to coppice under the stores, we cannot have that number of trees. But there is no reason why a certain limited number of "stores" should not be kept, even though nothing grows directly under them, provided that this does not involve too large a sacrifice of space, and consequently of coppice production.—(TR.)

The working scheme has for its object the proper development and utilization of both these elements in the capital, or material for exploitation.

As regards the coppice there is no difficulty: the plan is arranged exactly as for simple coppice.

As regards the "stores," it is easy to understand that the existence of these trees is, to a certain extent, a hindrance to the growth of the coppice-shoots, while at the same time it largely increases the value of the forest capital, or standing crop.

Hence, the scheme for reserving the stores *(plan de balivage)*, that is to say, the scheme by which we determine the number and exploitability of the trees reserved, must vary in each forest, and often in each felling of any particular forest, according to the species, the nature of the soil and climate, and the wealth of the proprietor.*

Scheme for reserving stores.—I will not enter into an examination of the methods employed, in order to determine the number and distribution of the stores. They depend on the end aimed at by each proprietor; or, in other words on his own interest and necessities.

If you wish only to consider the amount of loss you will suffer in growth of coppice-shoots; then the scheme for reserving stores will be based on the probable size which each will attain in a given period, and on the question what amount of shade the coppice will bear; these are *data* to be gained solely by experience and a knowledge of facts.

This consideration, however, is only one side of the question; and the interest of each proprietor may suggest, as a balance to the loss indicated, certain advantages *per contra*, which he may gain from a good growth of timber trees among or over his coppice.

For there is a very considerable difference between the value of a stem cut at coppice age, and that which a stem allowed to stand 30 years longer will acquire: and this consideration may induce the owner, when making his coppice cutting, to spare a large number of reserves. For example, if we estimate the value of a coppice stem, aged 30 years, at four annas, and the value of the same stem when aged 60 years at one rupee eight annas, it is evident that the owner's money is invested at a rate above 5½ per cent. per annum, compound interest. Is it possible to find a better investment—a saving's bank giving handsomer interest?

* The more trees the forest owner reserves, the richer he must be, that is, the better he can afford to defer realizing part of his crop, instead of realizing the whole as firewood, &c., in a short period.—(TR.)

The scheme for reserving stores is then the result of a calculation, of which the elements are—the value of the timber trees, and the injury caused by them to the coppice growth. It is easy to see that the solutions of the problem are various, and depend on the circumstances of the owner,* on his present and future needs, on the rate of growth of the trees, and on the probable value of the timber yield, with reference to the demand, and the means of transport available.

It is always desirable then to have a distinct scheme for this portion of the management, as well as one for the working of the ordinary coppice.

The owner of a forest of 300 acres worked as coppice on a rotation of 30 years, at the rate of 10 acres a year, may adopt, for example, a scheme for reserving stores which will consist in leaving on each felling after it is cut over:—

Per acre,	..	40 trees,	aged	30 years.
,,	..	12 ,,	,,	60 ,,
,,	..	4 ,,	,,	90 ,,
,,	..	1 ,,	,,	120 ,,

The standing crop, as regards the stores in each felling, is composed of:—

400	young	stems.
120	middle-aged	,,
40	old	,,
1	mature	,, (*vieille écorce*).

The capital taken for the whole forest will be:—

12,000	trees,	..	..	..	30–60 years.
3,600	,,	..	..	..	60–90 ,,
1,200	,,	..	..	..	90–120 ,,
300	,,	..	..	..	120–135 ,,

Total, 17,100 trees.

The essential character of the capital in a stored-coppice forest, is to have a graduated scale of *ages on each* felling, and not merely on the total area of the forest. This arrangement allows the cutting of the stores to be varied in any year according to the state of each felling, and to the proprietor's convenience.

The method of stored-coppice management, which has been too often underrated, is suitable to very different fortunes as well in the case of private owners as in that of Communes.

* Thus, in the State and Communal forests, the scheme consists in reserving 20 stems per acre of the same age as the coppice shoots, and not cutting those that are twice (60–90) or three times as old (90–120) till they show signs of decay, or will not benefit by being left standing for another rotation (Ordonnance of 1st August, 1827, Arts. 70 and 134).—(AU.)

Register of the working scheme.—For the very reason that the working of the reserved trees is so susceptible of variation, it is more than ever necessary to keep an exact record of results. The owner should always be able to know exactly the *financial condition of his forest. If his income* will bear the charge of a suitable establishment, his agents ought at any time to be able to test the propriety of the operations of the executive. It too often happens, even in very large businesses, that the executive managers, wishing to please the proprietor for the moment, have adopted a plan of working which, though it is attractive at the time by reason of its large immediate returns, really leaves the property in an impoverished condition, and with no future to look forward to.

*   *   *   *   *

The register (*cadre de comptabilité*) which we have given for ordinary coppice management is easily adapted to stored-coppice. It is necessary, however, to notice one difference, which is not in its form, but in its nature. When we are accounting for fellings cleared by area, it is known that the felling once cleared will be taken into account again (as re-stocked) for the next rotation, with the same area.

It is sufficient then to note in the register that such a felling has been cut over. It is otherwise with trees of timber-size: each felling has a variable number of trees, and a selection is made each year of the trees to be cut, and of those to be left. It is necessary then to note how many are taken and how many left.† Without that, it would not be possible to give an exact account of the state of the fellings; and the owner could never know the actual (financial) state of his forest.

In the example already given, 300 acres of forest are worked in the period of 30 years, 10 acres each year. (There is no question here of a special portion of the estate set aside as a reserve). The register of the stores in the forest will be kept in the following manner:—

---

* The passage omitted would be unintelligible to the English reader; it alludes to the necessity of being in a position to account exactly for the forest in case of a commercial liquidation (or separation, &c.), or in certain cases where there is the usufruct of a forest, and by law (Code Civil Court 591) the usufructuary would not be allowed to take any trees, unless he had proper schemes in writing which proved that a certain amount of timber was the *yield proper*, and at his disposal, and was not an attack on the capital itself.—(TR.)

† It would be useful to note here that we are not referring to anything similar to the "fourth in reserve" as in simple coppice. Nothing prevents us from sparing some of the stores destined, according to the working scheme, to fall in any particular year. Such a course might be useful, and enable us to *dispense with a* "fourth in reserve." In forests where the owner's foresight has reserved a particular part of the area, or has retarded the fellings in certain compartments, the particular area, or the compartments, remain stocked with their stores; but it is unnecessary to specify these precautions in the scheme for reserving stores.—(AU.)

FELLINGS.	1	2	3	4	5	6	7	AND SO ON	TOTAL.	SPECIAL RESERVE.	REMARKS.
Quantity of Stores in the felling.	Young 380. Middle 125. Old 54.	410 118 49	421 123 47	250 102 63	390 110 62	404 137 40	502 95 60		17,100	None.	
1880	375 400 124 60	..	..	..	..	..	..	..	375		
1881	..	406 410 126 51	190 215 75 21	..	..	..	..	..	588		
1882	..	..	204 210 70 30	..	..	10	..	..	214	..	10 oaks.
1883	42	..	..	239 409 127 49	..	..	..	..	281	..	42 wind-falls.
1884	..	..	..	..	380 420 110 60	..	..	..	380		
1885	..	..	..	..	..	388 401 122 61	..	..	388		

[The student will notice, that in the example first given the total number of trees destined to grow to timber size was 17,100 and was supposed to be evenly distributed over every acre, so that each felling of four acres would have exactly the same number. In the present table the number of trees (stores), in each felling of 10 acres, is given with some variety, (as it would be in nature,) with the same total].—[Tr.]

In this table the timber trees in each felling are noticed at the head, and for brevity's sake they are grouped under the three principal ages (instead of four as previously). Opposite each year of cutting is a horizontal bar in the column, and the figure above it represents what trees are cut; and the figure below, those which are left standing.

On following down the page of the register, it will be seen that in 1880 the felling No. 1 was cut over. In 1881 the owner made the cutting for that year, and half of that for 1882 was anticipated. In 1882 therefore, he had to restrict himself to the remaining half, but as he specially wanted ten oak trees, he cut them by anticipation out of felling No. 6. In 1883 he cut over No. 4 as intended, and sold 42 wind-falls in No. 1, &c., &c. In each case the reserved trees are mentioned in their general category of age, whilst the trees cut are stated in the lump only; there would be no object in stating of what class these were, or how many of each class.

Thus in felling No. 1 there were actually 559 trees of all ages, and 375 were cut, leaving 184, and 400 new young stems were selected to be spared from the coppice cutting of that year. Strictly speaking the balance ought to be exact, that is to say, the number of trees given over to cutting (375) ought to be equal to the difference between the total number of stores on the felling, and the number left (other than stems newly selected to stand over). But it is not possible to work this with mathematical exactness; there are errors of counting, accidents, loss, &c., which have to be allowed for; as in all other business transactions. The working party will put down actual facts, and the control will know how to draw inferences for future guidance.

This balance sheet of "stores" is supplementary to the ordinary register of the coppice cuttings. It would be possible to add the figures for the cutting by area, but it is clearer and more convenient to keep the two registers separate. The only merit of a record of this kind is for it to be very simple, and the more considerable are the interests involved, the more does simplicity become practically useful.

It will not be any anticipation of the observations to be made in subsequent chapters, if we remark that—

(1). The form of these registers is designed so as to adapt itself to all kinds of working schemes and fellings.

(2). The only rule to be observed, is to open a separate register for each kind of felling executed in a forest according to a pre-determined plan.

PART III.

Working schemes for Forests, with a large capital of standing timber.

HIGH FOREST.

CHAPTER I.—*Regular High Forest.*

From an economic point of view, *high forest* is a system of management for woodlands, for which a large capital of standing timber is essential, whilst from a cultural point of view, the same word signifies a system in which trees are reproduced by seed. The high forest system can be carried out in two ways; in the *regular high forest* method, where groups of trees of each age category are cultivated on separate areas; and in the *selection method,* which will be described in Chapter II.

I will follow the same plan in describing high forest management, as I have already done in coppices, *i.e.*, taking for example an area of 300 acres with a rotation of 120 years, I will first indicate the procedure employed in framing a working scheme for a forest with a complete standing crop of trees of all ages from 1 to 120 years, situated in a manner sufficiently regular for the name of *regular high forest* to be applicable.

I will not refer to the procedure employed to fix the period of rotation most advantageous for the proprietor. This would be beyond the scope of an elementary work. Proprietors are generally satisfied with counting the concentric rings of the felled wood, and thus estimating at what average age the trees would yield timber of such dimensions as it is to their interest to produce.

§ 1. *High Forest, with a complete standing crop.*

A.—*Working scheme of a regular high forest with a complete standing crop.*

TWO CLASSES OF PRODUCE IN HIGH FORESTS.

Before indicating the procedure of the working scheme, which enables us to decide at a glance whether or not the standing crop is always complete, and to follow the order in which the fellings will be made, it is useful to note, that in the high forest system the fellings are of two classes, each founded on the natural growth of the trees.

The first condition of high forest management is the natural regeneration of the forest, *i.e.*, regeneration by seed from the

standing trees. When any part of the standing crop has become exploitable,* *regeneration* fellings are made, in which the reserves, or *parent trees*, are left close enough to protect the seedlings from drought and frost; they are followed by secondary fellings, in which the reserves are spaced so as to allow room for the development of the seedlings, and at length the final felling frees the latter entirely from the cover of the old trees.

All these different fellings taken together, as they are only so many phases of the same operation, are called *regeneration fellings*, and they furnish the *principal produce* of the forest, since they are the most important and are only carried out on exploitable timber.†

This the first class of produce which can be obtained from a forest managed as *regular high forest*, but its power of production does not stop there. If we consider young growing trees, and follow their growth till they are exploitable, we shall notice that many of them become gradually overshaded by the larger trees, and eventually perish: a wood commences, for instance, by having 4,000 stems to the acre, and at an age of 120 years will only contain 120.

The growth of woods in this respect follows a law still unknown to us, and the knowledge of which would be most useful in forest operations (*vide ante* Vol. VIII., page 230).

Vegetable physiology fortunately furnishes foresters with a rule for their guidance, which supplies to a certain extent the want of this experimental law.

The production of wood in a forest is proportional to the mass of the foliage, and from this physiological maxim, which has been proved theoretically, we can conclude, that if we are careful to remove the suppressed stems, from time to time, whilst *maintaining the continuity of the leaf canopy*,‡ we should secure the whole produce of the forest, for we should obtain timber which would otherwise have been lost, without in any way diminishing the cubic contents of the mature crop. It is on this consideration that the practice of *thinnings* is founded, and these yield secondary produce to the extent of 15 and 25 per cent. of the principal produce.

* *i. e.*, has attained the age fixed for the chosen rotation.—(TR.)

† Since, as a matter of fact, only more or less irregular forests are met with, the name of *principal produce* is also given to the fellings of mature trees in such forests. *Principal produce* in high forests, in a general way consist of all that makes up the "*possibility*" in fellings by cubic contents. We will define "*possibility*" further on.—(AU.)

‡ The continuity of the leaf canopy is said to be maintained when the crowns of the trees touch one another without the action of the wind. MM. Lorentz and Parade (*Cours de culture des bois*, No. 406).

Working schemes for high forest should then aim at ensuring regularity in these two classes of cuttings, and we will first look at the matter as regards the principal fellings, which, in a regular high forest, comprise only the regeneration fellings.

Periodic blocks.—In coppice with 20 years' rotation, we divided the forest area into 20 compartments, to each of which a certain date for felling was assigned; this was possible, because in coppice one year suffices for the regeneration by stool shoots, and because the latter can from the first year be exposed without any shade, or protection. But in high forest this is not the case; seeds are not produced immediately, the seedling once produced requires a certain amount of shelter, which must be more or less prolonged according to its species; and it is often only after a lengthened period that seedlings can be left to themselves, and the area of the cutting considered as completely regenerated. If then we were to divide our 300 acres into 120 compartments of $2\frac{1}{2}$ acres each, corresponding to an annual felling, we should not satisfy any of these cultural exigencies. It is, therefore, advisable to divide the forest, not into 120 fellings, but into a certain number of blocks, each intended to furnish produce for the period of time during which, not only can the soil be re-stocked by self-sown seedlings, but also, these seedlings, having once sprung up, can dispense with every kind of shelter and protection.

This interval of time, varying according to climate, soil, and species, is called a *period of regeneration*, or simply *a period*. It will be understood, that to estimate it will require experience, and that its proper length can only be decided by careful observation. A proprietor who is willing to aid nature by cultivation, and by planting artificially without considering the expense, will select the shortest possible period, whilst one who prefers natural agents, will, on the contrary, be obliged to prolong the period. In this, as in every other business, the proprietor should be guided by an intelligent regard for his own interest, and whilst weighing the advantages, and disadvantages, one against the other, it should not be forgotten, that trees left standing to shelter the soil, and protect the seedlings, will generally compensate by their accelerated growth for the delay, which nature often causes in regenerating a felling. In order to get clear ideas on the subject, suppose that the inventory of the standing crop, the analysis of the forest, or to speak as a forester, the register of compartments, should give the following :—

A.	15 acres,	Oak, sparse, with seedlings,	..	150 years.
B.	$12\frac{1}{2}$,,	Beech, almost pure, with seedlings,	..	110 ,,
C.	$22\frac{1}{2}$,,	Beech, ash, and oak,	..	105 ,,
	50	Carried over.		

	50	Brought forward.		
D.	25	acres, High poles, silver fir, and beech,	.. 90	years.
E.	37½	,, High poles, silver fir, rather sparse,	.. 80	,,
F.	36¼	,, Densely stocked poles, silver fir,	.. 70	,,
G.	6¼	,, ,, ,, ,, spruce,	.. 60	,,
H.	68¾	,, ,, ,, ,, silver fir & beech,	40	,,
I.	55	,, Saplings, beech,	.. 30	,,
J.	21¼	,, Seedlings, beech, and silver fir,	.. 5	,,
Total,	300	,,		

In this forest the standing crop is complete, for in high forests differences to a certain extent, in ages and crops, are not material. Since compartments of similar ages follow one another successively, and their standing crops nearly correspond to their conditions of vegetation, the forest may be considered regular. If the period of regeneration has been fixed at twenty years, there will be six periodic blocks, each containing 50 acres. In the case of coppice the 20 *fellings*, each destined to be felled in one year, were divided by cleared lines; in high forests, the compartments, or portions of compartments, which will go to form each periodic block will be grouped together, and each of the six blocks assigned for the produce of every 20 years will be marked out on the ground, and their boundary pillars erected. The principle of this division into equal *periodic blocks* is founded on the supposition that they will each yield equal produce. This may not be the case, and in fact seldom happens in hill forests, where the slopes generally produce more wood than the plateaus, and where aspect has considerable influence on vegetation. If such inequalities are met with, we will be satisfied by adding a few acres to the worst of the blocks, so as to equalize the produce as much as possible; but this is a matter of judgment and experience, which cannot be measured by co-efficients, nor in any precise way.

CRITICISMS ON "NOTES FOR A MANUAL OF INDIAN SYLVICULTURE."

In the following paragraphs I will attempt to answer Sw.'s remarks, which appeared in the Number of December last. It will be remembered that I divided those remarks into sections distinguished by characteristic letters. In this paper, instead of repeating the substance of the criticism in question, I shall merely prefix the corresponding characteristic letters to my replies.

(A). Sw. finds fault with me for arbitrariness in fixing the maximum height of a shrub, which is also my minimum height for a tree. The only distinction he would have between a tree and a shrub is that the former "carries up a single stem for some distance from the ground and then begins to branch," whereas the latter "branches at once at or near the ground." I myself wished to adopt this distinction, but had to give it up. The *Cupressus torulosa* at Naini Tal reaches a height of over 100 feet and a girth of at least 6 feet, while its lowest branches still all but sweep the ground. This is also true of a great many deodar, and certainly of the European spruce. Now would Sw. say that these species were shrubs? Again, there are many species like *Gardenia turgida*, *Euonymus tingens*, several *Randias*, some palms, ferns, &c., which generally attain a height of less than even 20 feet, but carry up a single stem without a branch to a distance of 7 or 8 feet from the ground. Surely no one would call them trees. According to my nomenclature they would be *arborescent shrubs*, a combination of words which appears to me to describe them as accurately as the most exacting critic can desire.

I do not, therefore, see how we can avoid fixing a limit of height, which Sw. considers illogical. By attempting to be too logical, we are forced into the error of calling an erect woody plant 100 feet high a shrub, because it branches at or near the ground, and a palm 8 or 9 feet high a tree, because it does not branch at all. The only point about which there can be any dispute is the figure to which the height should be limited. 25 feet seems to my own sense of proportion a reasonable figure.

The case of palms however, reminds me that I must omit all reference to branches, and accordingly alter my definition of a *tree* thus:—

"A TREE is any woody plant which carries up a single stem to a certain height above the ground, and which is, besides, capable of attaining a minimum height of 25 feet."

The definition of a *shrub* requires the addition of the word "generally," thus:—

"A SHRUB is a woody plant incapable of attaining a greater

height than 25 feet, and which generally branches at or near the base."

The well-known American Botanist, Asa Gray, gives the following definitions in his "Elements of Botany."

"*Shrubs* are woody plants, with stems branched from or near the ground, and less than five times the height of a man. A shrub which approaches a tree in size or imitates it in aspect is said to be *arborescent.*"

"Trees are woody plants with single trunks, which attain at least four or five times the human stature."

(B). I am much obliged to Sw. for correcting me as regards the maximum height attained by *Quercus semecarpifolia* and toon in North-Eastern India. The names of those trees will be struck out from the list of examples given.

(C). Sw. is probably strictly right. But I should like to see the matter further discussed before changing my definition.

In combating my use of the word "bole," Sw. unwittingly falls into an inconsistency. Under (A) he insisted on the essential character of a tree being its carrying "up *a single stem for some distance from the ground and only then beginning to branch;*" here he asks me "where the bole ends, if the tree has *branches close down to the ground,* as will *often* happen."

(D). The use of the word "Fall" does not prevent the use of the word "Yield." Each term expresses the same idea from two different points of view. I do not see any reason for giving up the former, although I intend to employ also the latter word in its appropriate place.

(E). I submit to Sw.'s correction. The objection he brings forward to my use of the word "Reserve" did not at any time escape me; but I wanted a collective noun by means of which to denote all the spared trees taken together, and I thought it well to continue to employ the word in the same sense in which it occurs in Mr. Smythies' and my translation of Bagneris' *Manuel de Sylviculture.* This was, of course, done tentatively, like the adoption of every other word of my terminology.

I had intended, if my adoption of the word "Reserve" was sanctioned, to term the individual trees of a High Forest Reserve *Standards,* and those of a Coppice Reserve *Stores.*

Sw. will thus see that I was not going to pass over the word "standard." But his objection does not supply me with a substitute for "Reserve." Doubtlessly we can do without a collective noun, which would, however, if we could get one, be always extremely useful and convenient.

(F). All trees, even the most shade-bearing, require light for their existence, and aretherefore, more or less "light-demanding." To be *light-demanding* is hence not the same as to be *shade-avoiding* and the opposite of *shade-bearing*. To take a well-known case, the *Mesua ferrea* is admittedly an extremely shade-bearing tree, and yet requires a great deal of light to acquire its finest proportions.

(G). I am much obliged to Sw. for the verbal alteration he suggests, which makes my meaning much clearer.

(H). By mentioning deodar and the silver fir together, I, of course, do not imply that the one is as shade-bearing as the other. Both species have been given by me, among several others, as instances of shade-bearing species.

The respective degrees in which the several species bear shade will be appropriately explained in Book III. of the Manual, which Book will contain a special account of the habits and requirements and mode of culture of our principal species; whereas the Notes I am now publishing are for Book II, which will explain the general principles of sylviculture applicable to India.

(I). Sw.'s meaning here is not quite clear to me. Does he object to the idea of volition on the part of vegetable organisms involved in the word "abhorring"? But it is surely hypercritical to object to my use of that word, because strictly speaking it implies that idea. I am writing practically on a practical subject, and I could not obviously attempt to enter into abstruse questions of biology and metaphysics. I have employed perhaps a poetical turn of phrase in order to express in an emphatic manner the strongly shade-avoiding nature of the trees referred to. If I am precluded from using such phrases, then many others, such as *light-demanding*, &c., which Sw. himself and foresters all over the world employ over and over again, must be banished from our vocabulary.

(J). After my reply to Major Van Someren's objections (*see* last December Number, pages 286-7), I need say very little here. A tree can be shade-bearing and yet require plenty of light in order even to grow up beyond a height of as little as 2 or 3 feet. For the amount of shade we have in the forests of the North-West and Central Provinces and Oudh, young sál is conspicuously shade-bearing, and almost wherever you go, you find an advance growth of it on the ground, which persists under the close leaf-canopy above, but does not and cannot shoot up until that leaf-canopy is opened out, and direct sunlight freely admitted. Sw. will thus see that I am not guilty of any inconsistency in saying that sál is shade-bearing and yet "partial to light."

(K). I ought to have said "the sissoo alone can grow in

certain places on the alluvial shingly banks and beds of some rivers." The omission of the words "in certain places" has led to Sw.'s objection.

The result of my own observations and of some others (notably Mr. Lowrie, to whom I am indebted for many valuable hints), is that sissoo can be propagated only by water, and then too chiefly, if not solely when the soil is a loose silt without any great consistency. Hence, we can obtain the natural regeneration of that valuable tree only on land that is at least occasionally flooded and is not quite consolidated. Hence, the utter futility of expecting self-sown seedlings in high grassy plains, such as those which are being planted up in Oudh. As long as the silt is quite free, sissoo seedlings continue to come up and cover the ground, unless the whole land is swept or cut away by floods. As more soil accumulates and the silt consolidates, khair seedlings begin to put in an appearance and mix with the sissoo. As the land rises by the deposit of new matter and gets up above flood-level, the reproduction of sissoo diminishes until it entirely ceases, while khair seedlings can still continue to be produced. The preceding brief summary of facts explains to a great extent under what circumstances sissoo forms a pure forest, when it is mixed with khair and other species, and why in certain grassy plains, now well above the floods, the old flood-produced sissoo trees are unable to propagate themselves by means of self-sown seedlings.

In the preceding remarks I have gone somewhat beyond merely answering Sw.'s objection, but the very interesting nature of the subject will I hope be my justification.

(L). I must apologise very humbly if I have wounded any one's susceptibilities by including Man amongst "other animals." *Et ego homo sum nihilque humani alienum a me puto.* But in future, to keep out of such dangerous ground, where angels ought to fear to tread, I will adopt Sw.'s advice and give the lord of creation a sub-head all to himself!

E. E. Fernandez.

SANDAL.

Geographical distribution.—The sandal is found all over the Mysore plateau and the countries surrounding it, Coimbatore, Salem, Cuddapa, Bellary, North and South Canara, down to a level of about 1,500 feet. A few trees may be seen on the coast at Cannanore, planted in gardens. I do not know what the age of these may be, but one which I examined seemed to me to have as good scent as any growing on higher land, so that it might be well worth while for Government to make plantations of it on the coast.

It appears to prefer the equable climate of Mysore, where the temperature ranges from 55° to 95°. Frost is unknown to it. Drought, long continued, will sometimes kill it. Thus, in the famine year, trees succumbed in all parts of Mysore.

Sandal is not particular in the matter of rainfall. It is satisfied with 25 inches, and grows abundantly in places which get only that amount of rain. Again, in parts of Coorg and Manjarabad, it grows luxuriantly with 60 to 70 inches of rain, and in this case attains a much larger size. At Cannanore it appears to be fairly happy with 100 inches.

The climate which it mostly affects however may be characterised as dry, with long periods without rain, most of the rainfall being in July, August and October, and the rest of the year dry, with the exception of occasional showers in April, May, and June.

Soil.—It is found on soils of various natures, but will not grow on saline, calcareous, or black cotton soils. It prefers the ferruginous loams common in Mysore, but is happy in poor gravelly and stony soil. It has been recently planted in rich forest mould in Naikery and other forests, and makes great growth in it.

As regards depth it is not *exigeant*, being a surface feeder; 3 feet is probably as much as it requires.

It prefers a free permeable soil, but it survives on the red loam, which in scrub jungles much frequented by cattle, often gets caked and as hard as sun-dried brick. In this case seedlings are very rarely seen. It avoids swampy places, but is frequently found near water where the soil is well drained, on river banks and on the bunds of tanks, and attains large dimensions in such places.

The hygroscopicity of these soils is various, with the gravelly and stony soils it is small, more with the red loam, and considerable in the rather stiff loam of the forest.

Locality.—Sandal grows on undulating ground, but often takes to hill sides, though it is not often seen on tops of high hills, the reason probably being that the tops have not long been denuded of high forest, but it may be that its seeds do not easily lodge on the summits, and also that it is too exposed to the winds. It is generally found in fields either in cultivation, or which have been cultivated formerly, in the scrub jungle round villages, or any low scrub jungle which has a suitable soil, and not far from cultivation. In high forest it is very rare, and then only in open spaces on a river bank, or the side of a nullah. This is probably due to the absence of birds to carry about the seed, as well as its dislike to being hustled by larger trees.

Dimensions.—The sandal is a small tree, attaining at most a height of 50 feet and 4 feet in girth, though this girth may occasionally be exceeded in exceptional circumstances. As a rule it has a height of from 30 to 40 feet, and is 2 to 3 feet in girth. In the dry plains of Mysore the lower of these dimensions is only attained, the larger dimensions are found in the districts more favoured with rain.

The ramification is rather close. The branches slender and pendulous at the end, especially in a luxuriantly grown tree.

The foliage is rather open. The crown is a round oval occupying about two-thirds of the tree.

It is fairly able to bear shade, to live and even grow pretty well under cover, and it is frequently seen growing under banian and other figs, and under tamarinds, with its crown interlaced amongst the branches of the large tree, but this is generally near villages, and when the shade becomes very thick the sandal languishes, although it continues to live and make growth for years under these conditions. In light open jungle it springs up best under the light cover of bushes; a scrub jungle of this sort with plenty of open space seems to offer the best conditions for its propagation. The young plants have great capacity for pushing their way through this sort of low cover, provided it has plenty of lateral light and air.

The sandal tree is an evergreen. The foliage however gets thinner in protracted monsoons with continual rainy weather, and also in the dry season. A flush of new leaves appears during the early showers in May, and after the monsoon in October.

Sandal becomes fertile at about 10 years old. In some of the plantations in rich forest soil it has flowered at 3 years old: and this early flowering tends to show that the rich soil is not adapted to the tree; and it remains to be seen whether the seed is of any use.

It has a long flowering season—from February till April. The seed forms from March till May.

It ripens in May and June, and during the monsoon, if a light one, or the ripening is sometimes put off till after the monsoon.

There is nearly always an abundant annual seeding.

The seed has a fairly long vitality if kept perfectly dry. Rats and squirrels eat it with avidity, and sometimes commit great depredations in seed beds. It is apt to rot with too much rain, and this happened to a great extent in our plantations last monsoon (1882), during which there was *double* the average rainfall in Coorg of the previous 25 years.

The seed is easy of germination if it can escape its enemies—the rats and squirrels. Natural regeneration by seed is assured in open low scrub when there are plenty of birds, and if it is protected from cattle grazing and fires.

It does not grow from stool shoots, but profusely from root suckers. Plants whose stems have been burnt, or otherwise injured, almost invariably send up a mass of root suckers, as do also the roots of exploited trees if not past their maturity.

Exploitation is effected by uprooting the trees and extracting all big roots. The smaller roots left in the ground often send up a quantity of root suckers, and this faculty continues to a considerable age, probably 50 or 60 years, but I think it is strongest when the tree is young. I have frequently seen trees of about 20 or 30 years old that have been burnt, send up a great quantity of suckers, but have not noticed this in over-mature trees.

Under favourable conditions the sandal plant will grow about 1½ to 2 feet high the first year, and will add 2 feet more the second year. In rich forest I have seen them grow 3 to 4 feet the first year, and about as much the second year. I have some plants not yet 3 years from seed, which are 11 feet high, and it remains to be seen to what height they will attain. A few trees planted 18 years ago at Fraserpett are at present 25 feet in height, and 18 inches in girth, and contain a core of heart-wood of about 2 inches thick, all the rest being white wood.

The age of a mature tree is reckoned to be about 50 years, but probably in plantations with nothing to interrupt its growth, it will come to maturity at a much earlier age, say 40 years. Sandal is very sensitive to fire and is easily destroyed by it. Much damage is done yearly by fires originating from the burning of weed heaps, &c., in the ryots' fields, which burn the trees in the hedges, and spread to the surrounding scrub jungles. Thus the growth of the plants is much retarded, although they constantly send up root suckers; but if a mass of dry stuff is collected round the trunk of a tree, and burnt, the tree will probably succumb. A mature tree killed by burning can be exploited, but a half grown tree is useless, as it has no heart-wood.

Deer and cattle do much harm by eating off the leaves and young shoots, of which they are very fond. Cattle are therefore strictly kept out of plantations, but it is not so easy to manage the deer.

Sandal is notably a tree which likes to grow in the open, apart from any associates. In scrub jungle it keeps its crown free of the surrounding scrub, and in case the latter returns to a state of forest, the old sandal trees would continue to grow slowly to their maturity; but very few seedlings would establish themselves under these conditions.

The best results in raising sandal artificially have been obtained by sowing seeds in lines 6 feet apart, which are picked up with a pickaxe to the depth of about 9 inches. The clods are broken up, and the lines smoothed over. One man puts in the seed at 2-3 inches interval, and ½-inch deep, whilst another sows dall (*Cajanus indicus*) somewhat closer in the line. This is done in the beginning of the monsoon, is a very simple operation, and nearly always gives a sufficient crop. The dall comes up, and protects the young seedlings by its shade in the hot weather. In the second monsoon, the superfluous plants are taken out, and transplanted to another part of the plantation. It is advisable to loosen the soil round those which remain. Weeds should be kept down, and it is most important to keep out cattle, as they soon exterminate the plants. If it is desired to plant up jungle land, it is necessary to fell and burn the jungle completely at first; no good results being ever obtained under shade. The plantation may be said to be established the second year, all that is necessary to do after that, being to keep down weeds by a weeding once a year, or in the rich soil of the forest twice a year, and, above all, to keep out cattle and fires.

F. B. D.

STORING IMPORTED VEGETABLE AND FLOWER SEEDS.

The following remarks are made with a view of drawing forth an expression of opinion from those who have had experience in keeping imported cold season vegetable and flower seeds in a germinative condition throughout the rainy season. Complaints are frequently made that certain seeds have not germinated, and for that reason have been classed as bad. There are many ways by which seeds may be brought to this condition, and I believe a bad method of packing and storing to be one of the most common. Seeds of vegetables and flowers, raised in this country, do not require much care in storing. If kept in a dry room and looked over occasionally, such appliances as hermetically sealed boxes, bottles, &c., are entirely unnecessary. It is very different however with imported seeds. A few days' exposure to the damp atmosphere of our rainy season is very fatal to their vitality. European seeds-men usually send out their seeds to this country in hermetically sealed tin boxes. When sent by a respectable firm so as to arrive just when required for sowing, they will, as a rule, germinate freely. When failure occurs under these circumstances, the gardener who had charge of their management must be at fault. On the other hand, if, as is often the case, they arrive a month or two before the season for sowing, and have been kept in the sealed tin boxes until that time arrives, no one should blame the gardener, or feel surprised if they do not all come up. Packing

seeds in hermetically sealed tin boxes, is without doubt, one of the best methods for this country; for I believe their vitality is greatly injured if they remain in the boxes for a month or two after arrival. All good seeds contain a certain percentage of moisture, and the natural heat of our climate causes this moisture to be continually given off, and when confined within a sealed tin box it must condense and thereby injure the seeds. I strongly advise opening hermetically sealed boxes of seeds immediately on arrival, and transferring the contents to a well made wooden box. Any rough box will do, provided it has a close fitting lid. The bottom of the box should be covered with a layer of charcoal dust. It is also a good plan to fill a few small bags with the same material, and place them amongst the seed packets. Charcoal is a capital substance for inhaling any moisture given off by the seeds, or any that may find its way within from the atmosphere. Bottles with glass stoppers, when used for keeping seeds, have the same injurious effects upon their vitality as hermetically sealed boxes. I have noticed that seeds, to all appearance quite dry, when placed in a glass stoppered bottle give off, within ten or twelve days, sufficient moisture to cover the inner surface of the vacant glass, with a heavy coating of dew. This is not so soon generated if common corks are used instead of glass stoppers; I suppose the cork inhales the moisture given off. When bottles are used for keeping any rare kind of seed, it is much the best plan therefore to use a common cork. This plan of opening hermetically sealed tin boxes immediately on arrival is much at variance with that adopted by other authorities, and as I consider the subject to be an important one, I shall be glad if any of the readers of the "Indian Forester" will record their experience.

W. G.

FURLOUGH.

TO THE EDITOR OF THE "INDIAN FORESTER."

SIR,—Cannot something be done to bring to the notice of the authorities the hardship suffered by some of the members of the Forest Department, by their being debarred from the privilege, accorded to their more fortunate brethren, of enjoying two years' furlough after eight years' service? I am sure that if the matter were properly represented, our liberal-minded Viceroy would extend the privilege to us all. It is such a small matter to Government, and would be *such* a boon to the few unfortunate individuals, who at present can look forward to only one year at the end of nine years' service! Of two men serving in the same place, performing the same duties, and drawing the same pay, one goes home with the pleasant prospect before him

of enjoying two whole years with those nearest and dearest to him. The other is left behind; imagine the heartache of this latter unfortunate, who has the same ties and the same dear ones at home, but who must remain here another year, simply because a hard and fast rule, arbitrarily fixed, operates against him.

HOME-SICK.

NOTES ON "A TRIP THROUGH CHAMBA."

TO THE EDITOR OF THE "INDIAN FORESTER."

DEAR SIR,—In your January Number is a bright and interesting note on a tour in Chamba. Mr. J. C. McDonell notices (at suitable elevation) a very large tree of a species which he calls *Rhus punjabensis* (the vernacular is printed Kakkuein, it should be Kakkrein, or more properly Kakrain). Is the writer sure of the species? It is much more likely to be *Rhus (Pistacia) integerrima:* the natives confuse several of the *Rhus* species under the names of Kakar, Kangar and Kakrain. Brandis speaks of *R. punjabensis,* which is not very common, as a moderate sized tree, 35 feet high and 4 in girth, and I think the size Mr. McDonell mentions could not be attained by this species. *Pistacia* is occasionally found of a very large size; it yields the beautiful 'zebra-wood' which is so promising for cabinet work, but of so little real use, as it takes years to season—splitting after even ten years' keeping, and being very liable to warp.

By the way I wish other Foresters would imitate Mr. McDonell's example, and write accounts descriptive of tours in some of the great forest regions known to many of us only by name. How interesting would be a descriptive sketch of the Ahiri forests for instance, of the Melghat and other places that we hear of in Reports, and there are many other peculiar forests in Ajmere, the Punjab, Assam, and elsewhere, quite unknown to many. It is true that we can pick out of official reports, a list of the trees found there, but this does not give one an idea of what the forest is like.

B. P.

V. Notes, Queries and Extracts.

French Forest Department.—It may interest some of our readers to hear that by an order of the President of the French Republic, the following grades of the superior executive staff in the French Forest Department have been re-organised since the 1st August, 1882. *Conservateur, Inspecteur, Inspecteur adjoint, Garde général.* The grades of *Sous-inspecteur, and Garde général adjoint* have been abolished, and all officers appointed from the Nancy Forest School will rank as *Inspecteurs adjoints,* until they are entitled to promotion to the grade of *Inspecteur,* and will at once receive salaries of francs 2,000 per annum. Officers appointed from secondary schools will hold the rank of *Garde général.* An experimental forest station has been established at Nancy, to which five working circles (series) of the Forests of Hayes and Amance have been assigned, and all marking and estimation of products in these will be effected by the students of the Forest School.

Notes concerning Mahogany with references to its Introduction into England.—Almost any information relating to that highly popular furniture wood, mahogany, can hardly fail to be of interest to those who may be commercially associated with it. Mahogany possesses above all other woods such distinct characteristics that it is no wonder information concerning it should command, as it assuredly does, such peculiar interest. To begin with, the history of its species dates back to the very earliest periods of which we have authentic record.

The ancients, no mean judges of beauty in respect to woods, appear to have attached the greatest regard to mahogany, and it is but fair supposition to believe that they were acquainted with none but inferior kinds. The botanical fact that the average mahogany tree requires at least 500 years in which to become fully mature, seems of itself to stamp the wood with a certain value.

Graphic descriptions might be furnished of the workings of the forest gangs led by a "mahogany hunter," slashing his way through the thick and tangled vegetation of a tropical forest, and who, covered with the juices of luxurious vegetation which spurt out of the grasses cut by his constantly-working sword, guides them unerringly to the desired spot, that from the summit of some tall and distant tree his keen and experienced eyes have singled out. Telling narratives might be

written concerning the progress of the logs as they are being conveyed in the rude trucks drawn by oxen, from the forest to the river through which they pass *en route* to the coast line. Little indeed is reckoned of the patient toil required to effect the hewing down and trans-shipment of the logs. Under the heat of a tropical sun the heavy labour which the work necessitates is all but impossible, and so it is carried on at night, and the hewers and carters are guided to their labours by flaming torches. The scenes at the working stations in the density of the primeval and virgin forests of Central America are spoken of as being strange and weird. The regular thuds of the woodmen's axes breaking upon the otherwise prevailing stillness, the tottering of the vegetable giants, and their crashing falls in the solitude, the shadows from the flaming torches, which reflect the naked figures of the workers, are said to combine in furnishing a strangely interesting spectacle.

But a limited amount of reflection will suffice to assure any one of the difficulties attendant upon carting heavy logs through a forest teeming with vegetation, and in which there are neither roads nor even tracks. Every rivulet which must be crossed presents, in the absence of sufficient appliances, an engineering difficulty of no mean consequence. Even when the coast is reached, or rather when the logs have been conveyed to some place where they can be loaded on to the ship, a long and tedious sea voyage must be undertaken before they can be brought to our markets. Heavy and costly however, as the work undoubtedly is, much more labour and expense would be incurred, if they were necessary, for the gaining possession of the most beautiful wood known to mankind.

In the pages of a contemporary some discussion has recently occurred respecting the first introduction of mahogany into England. It may therefore be interesting to some readers of this *Journal* to have a precise account of the circumstances attendant upon the first arrival and employment of the wood in this country.

Mahogany was first brought over in the shape of planks, some time about the latter end of the eighteenth century. A noted physician, Dr. Gibbons, being about to build for himself a house in King Street, Covent Garden, London, his brother, who was a sea captain, trading to the West India Islands, brought over some mahogany planks thinking they might be of service to Dr. Gibbons. The workmen however, complaining that the wood was of too hard a nature to be worked by their tools, it was laid aside as being of no present service. A cabinet maker named Woollaston, carrying on business in Long Acre, next essayed to make a candle box of the wood, and finding his tools inefficient for the purpose, had stronger tools made,

and eventually finished the article. The wood was then so much admired, that it was determined to make a bureau of it, which was accordingly done. So pleased was Dr. Gibbons with his piece of furniture, that he invited many persons to come and examine it, and among others the *Duchess of Buckingham.* So greatly did the Duchess admire the piece of furniture, that she begged some of the wood from Dr. Gibbons, and instructed the cabinet maker—Woollaston—to make her a bureau also. The second piece of furniture was admired even more than the first, and from this circumstance mahogany sprang quite suddenly into favour, and became a wood of fashion.

This much may be said of mahogany—that in its living state it is one of the most noble and majestic of trees. So beautiful is the tree when in full bloom, and when covered with its pearly flowers, that it has been by Dean Barrington beautifully termed "The Giant's Nosegay." It flourishes in the forests of Central America, amid the most luxuriant vegetation of the universe, and is itself a tree of the most magnificent order. As a wood of commerce it is lasting in character, strong, of unequalled colour, and for beauty of texture has no rival whatever.—*Timber Trades Journal.*

India Rubber production in Brazil.—A pamphlet, lately issued in *Rio de Janeiro*, by *Senhor Pimenta Bueno*, calls attention to the great importance of this product, and the influence it has had on the commerce of Para, the value of whose imports and exports has risen from 26,332,580 mils. during the years 1849-1854, to, in 1874-1879, 108,702,684 mils., or fully four times as much during the last five years, while the revenue of the city has increased during the same period from 4,368,527,650 reis to 17,825,895,567 reis, having during the five years previously, say from 1869 to 1874, reached the large sum of 21,245,591,032 reis. To show the proportionate value of india rubber, as compared with other exports, the return for 1879-80 apportions them as follows:—

India rubber, ...	12,242,500 mils.
Castanhaauts, ...	1,473,800 „
Cocoa, ...	1,032,500 „
	14,748,800 „

On the other hand, the total exports from the two provinces of Para and Amazonas during the same period was 15,497,600 mils., a striking proof of the position held by india rubber. It is further stated that "the provinces of Para and the Amazonas import sugar, coffee, Indian corn, beans, and even mandioca flour!" Again, the writer of the pamphlet states that india rubber occupies the third place in the exports of the Empire, after

coffee and sugar, and yet how few of our readers are probably aware of this fact, Para occupying the extreme northern limits of the Empire, with its vast river, the Amazon, flowing past it.

The writer shows how, owing to the destructive manner in which the india rubber trees are cut down, this valuable branch of industry is threatened with serious diminution, if not almost extinction, and urges that means ought to be taken to regulate the cultivation and supply of this valuable article, a conclusion in which most people must agree, who feel an interest in Brazil, as well as the great river which gives access from Para to the Andes, and whose banks are covered with primeval forests, many as yet almost untrodden by the foot of man. A great increase in the value of the article is exhibited, that current being 3,100 reis per kilogram for fine quality, whereas in the year 1825 it was only worth 300 reis the kilogram. It may also be noticed that india rubber contributes 25 per cent. of its value to the general and municipal taxes of Para.

The naturalist Agassiz, in his great work on Brazil, devotes a large portion of it to the Amazon and its productions, extracts from which will be found in our columns, and he makes especial mention of the attention he received from Senhor Pimenta Bueno during his visit to that region.—*South American Journal.*

CEARA RUBBER.—It is just ten months since I put down the first Ceara rubber seeds, and I have already collected and sown ripe seeds, produced from the resulting plants. The largest tree is about 15 feet high, branches at about 7 feet, and now shades a circle of 10 feet diameter. Some others have reached the height of 10 feet without branching, but the greater number have branched at from $2\frac{1}{2}$ to 5 feet, and the seed-bearers are those that have branched lowest. As to the growth of this product there is no longer a question, and the value placed on the only sample sent from Ceylon seems satisfactory; but we have much to learn before we can pronounce it a paying industry. At 10 feet apart, we will have 436 trees to the acre, but we are still in utter darkness in respect to yield per tree and the cost of collection. Till those two questions are settled, it can hardly be considered safe to go largely into it. As for the cost of cultivation, exclusive of collection and preparing for the market, it would after the first year be trifling, as it is evident that the tree is able, with twelve months' start, to hold its ground against all competitors. The field of conjecture is a wide one, and I dare not go a step further in it. In front all looks an open plain, but beware of sloughs and pitfalls.—*Tropical Agriculturist.*

RAILWAY SLEEPERS IN FRANCE.—A recent number of the

Revue des Eaux et Forêts contains the following abstract of a long-delayed report on the above subject by M. Jacquin, Ingénieur en Chef des Ponts et Chaussées:—

In 1877 the six great French railway companies required 2,563,000 sleepers annually for the maintenance of their permanent way. Compared with the mileage, this amounted to 93 sleepers per kilometre (0·6 English mile) per annum, or to over 7,000 sleepers daily.

Assuming a single tree to supply on an average 10 sleepers (which is below the average of beeches, but above that of oaks), the maintenance of the French railway system necessitates the destruction of 700 large trees for every day in the year. When the projected extensions have been carried out the expenditure will amount to 1,000 large trees daily. To this enormous figure must be added the quantity required for repairs of rolling stock, which cannot be put down at less than 140,000 cubic mètres (about 5,000 000 cubic feet) in the year. Besides this, the construction of 20,000 kilometres of new lines, as proposed, within the next ten or fifteen years, will cause a further demand for 20,000,000 new sleepers.

With a view to the reduction of this enormous demand, the French railway companies have long been endeavouring, like others, to increase the *durability of their sleepers* by impregnating them with antiseptic substances, the two heretofore most used being cupric sulphate and creosote.

On the South and West of France lines, sleepers and telegraph poles impregnated with both these substances have long been in use, and are still in a perfect state of preservation. A creosoted beechen sleeper was taken up on the West of France line after nineteen years' *service. This is a remarkable example; but similar instances* may be met with on other lines; the real mean average l fe of such impregnated sleepers does not, however, appear to have been as yet satisfactorily determined.

After long experience, the Eastern French line gives the preference to gas-tar over all other antiseptics and creosotes, even oaken sleepers, the sap-wood, as well as the less indurated portions of the heart, absorbing the tar freely. The sleepers are not put in creosoting chambers, but are cut and dressed so that all the bearing surfaces are thoroughly impregnated. Under a pressure of 6 to 7 atmospheres, oaken s eepers absorb 7 to 8 kilogs. of creosote, beechen sleepers 30 to 35 kilogs. There is reason to hope that the larger quantities thus absorbed, may increase the power of resisting the elements of destruction in a corresponding degree.

Mr. Blyth has proposed a process of treating log or sawn wood with hydro-carburetted gas in close chambers, that is to say, exposing it to the action of ordinary high pressure steam, containing liquid hydrocarbons in a state of spheroidal diffusion. The inventor claims for the process that it effects perfect saturation of every part of the wood, whether green or dry, sawn or unsawn, with the protective substance. These promises, somewhat over-sanguine perhaps, have not yet received the full confirmation of experience.

The solution of the railway sleeper problem has been sought in another way. Stone, concrete, and cemented brickwork sleepers have come up again. But it must be remembered that these offer neither the conditions of elasticity, nor the facilities for attachment which are indispensable, so that there is no prospect of their general adoption. Then metal sleepers have been tried, and, could a good model be found, our great metallurgical firms would, no doubt, find a new element of industry in supplying the imperious demands of the iron horse. But, unfortunately, the experiments made thus far, on different lines, have not given satisfactory results. A metal sleeper, to be successful, must combine all the qualifications of resistance to a transverse strain, a good seat on the ballast, and stability in the mode of attachment of the superincumbent rails, and withal the outlay must remain the same. This is the point generally overlooked by inventors. It is not enough to have a perfect line on the opening day, it must be kept in working order, and to do this, so far as French experience goes, a larger outlay appears to be necessary with metal sleepers than with wooden ones. The results at present are therefore unfavourable to the use of metal sleepers.—*Timber Trades Journal.*

We note that amongst other prizes offered for horses, cattle, and agricultural produce, at a fair to be held at Dongargarh in the Central Provinces, to celebrate the opening of the Nagpur and Chhattisgarh State Railway, in the first fortnight in this month, the following list of prizes for Forest Produce:—

Class V.—Forest Produce.

		Rs.	Rs.
1	Lac—		
	1st prize, ...	10	
	2nd do., ...	5	15
2	Resin—		
	1st prize, ...	6	
	2nd do., ...	3	9
3	Hurra—		
	1st prize, ...	6	
	2nd do., ...	3	9
4	Gum—		
	1st prize, ...	6	
	2nd do., ...	3	9
5	Wax—		
	1st prize, ...	6	
	2nd do., ...	3	9
6	Honey—		
	1st prize, ...	6	
	2nd do., ...	3	9
7	Cocoons—		
	1st prize, ...	6	
	2nd do., ...	3	9
8	Iron—		
	1st prize, ...	10	
	2nd do., ...	5	15
	Total value of prizes in Class V.,		84

Similar prizes are also offered at a fair in the Saugor district, and the Central Provinces authorities are to be congratulated on their attempts to incite care in the collection and preparation of these valuable products of their Forests.

The following is from the last report of the Agricultural and Horticultural Society of India:—

Eucalyptus citriodora has taken very kindly to Bengal, and being sweeter scented than *Aloysia citriodora*, "sweet scented Verbena," besides growing to a good size, ought to make it a very popular plant, and one that no house should be without.

THE
INDIAN FORESTER.

Vol. IX.] March 1883. [No. 3.

TRANSLATION OF M. PUTON'S AMÉNAGEMENT DES FORÊTS.

General table of fellings.—In coppice the example we have given of the general table of fellings contains twenty fellings, one assigned to each year of the rotation; in that of high forest it consists of six blocks, each assigned to the six periods of the rotation, and each of these six *periodic blocks* may be composed of several compartments differing by their age, species, or by the future treatment which will be necessary. We should then preserve the compartment lines which we have used in making the description of the forest, and mark their position either by boundary pillars, or by short trenches. It will be readily understood that if compartment A, for instance, is stocked with oaks over an *advance growth* of seedlings, we must commence fellings there sooner than in compartment B, where the beech seedlings are well able to withstand the cover. It will, therefore, be very important to know the cubic contents of the timber which may be removed from each compartment, and also to ascertain at any given time, how much is left to be felled. We shall agree, the more readily, in admitting the utility of keeping these compartment lines cleared, after I have pointed out the way in which the register of the working scheme should be kept; but even now the advantage of preserving on the ground traces of the work of analysis, which has been made, is apparent; for otherwise the foresters would become as easily confused in working a forest, as in a farm where the fields destined for a rotation of crops have not been clearly marked out. When the compartments were laid out, they were distinguished by letters or numbers, and after they have been distributed amongst the periodic blocks, it is extremely useful to designate them by the number of their periodic block, to which the letters *a*, *b*, *c*, ... should be added according to the different crops which they contain; we have thus I*a*, I*b*, I*c*; II*a*, II*b*, II*c*; III*a*, III*b*, ... This method of notation at once shows to what periodic block any compartment may belong, and consequently when it will be felled; it prevents palpable faults in exploitation which might happen when the foresters are changed, and in a word, it

describes on the ground itself the general table of fellings, that is to say, the table we should always bear in mind, when about to manage a high forest scientifically. Since this table only contains six periodic blocks, it will be very simple.

General Table of Fellings.

Numbers		Areas, in acres					
Of Periodic blocks.	Of Compartments.	Of Periodic blocks.	Of Compartments.	Age in 1880.	Period for felling.	Average age at time of felling.	Remarks.
I.	a b c	50	15 12½ 22½	130 110 105	1880 to 1899	140 120 115	General description of works to be undertaken. Road 3 miles long along the course of the valley. The soil to be prepared for natural reproduction, so that we may not enter on a fresh periodic block till the former one is completely regenerated.
II.	a b	50	25 25	90 80	1900 to 1919	120 110	
III.	a b	48¾	12½ 36¼	80 70	1920 to 1939	130 120	
IV.	a b	50	6¼ 43¾	50 40	1940 to 1959	120 110	
V.	a b	50	25 25	40 30	1960 to 1979	130 120	
VI.	a b	51¼	30 21¼	30 3	1980 to 2000	140 115	
		300	300				

It would appear at first sight that the above table only refers to the principal *fellings, as it only prescribes the areas which* will be regenerated in a certain period; but it also refers to thinnings, for on examining it we shall see, that no thinnings must be made in periodic block No. I., in which regeneration fellings are at once to commence; that in periodic block No. VI., which is only stocked with young seedlings, thinnings will generally take the form of *cleanings*, or removal of inferior and

hurtful species;* in fact one will always know, that true thinnings will in general only be carried out in periodic blocks II., III., IV., and V.

Special table of fellings.—We have seen that the general table of fellings is complete in itself, and comprises all fellings which can be made during one rotation, and even the determination of the standing crop which will be operated on. But this will not suffice, and the working scheme must go further and prescribe the cubic contents, the nature, order, and succession of fellings, which whilst leaving the capital intact will yield the annual production (see page 234, Vol. VIII., "Indian Forester"); this is the object of the *special table of fellings.* A proprietor anxious to manage his forest well, will not be satisfied that he is not trenching on his capital whilst locating his fellings in the periodic block under regeneration, (or more simply in the *current periodic block.*) This 20 years' test will not be sufficient, he must also take the necessary steps to equalize the products which are to be realized each year within the period of 20 years. Hence he is obliged to sketch before-hand the sequence of the fellings which are to be made in that period, so as to convince himself, that he is not exceeding the figure of the possible annual yield, *i. e.*, of the *capability*, to speak as a forester.†

There will be, therefore, a *special table of fellings* for each period, which will comprise;—*1st*, Regeneration fellings to be made in the current periodic block; *2nd*, Thinnings to be made in the other periodic blocks. As it is impossible to foresee the future, and the state of the standing crop beyond a certain time; this special scheme is only prepared for the first period, whilst leaving to the end of each period, *i. e.*, 1899, 1919, 1939, &c., the care of preparing the special table for the incoming period, with which at present the proprietor can have no concern.

1*st*. *Principal produce.*—The special scheme should not only include regeneration fellings and thinnings, but it should also prescribe clearly and fully the cultural exigencies implied by them. Thus, regeneration fellings which yield the principal produce of the forest, can no longer be based on area, for if this

* *Eclaircies* or *thinnings*, are made with the object of shortening the duration of the struggle between individual trees of the crop, by removing some of weaker stems. *Nettoiements* or *cleanings*, are intended to free the more valuable species from inferior ones, such as softwoods, which might overtop them in the early stages of growth.

† *Possibilité*, is the amount of produce which can be taken annually and regularly from an immoveable property, managed under certain conditions,—without depreciating its value; (to speak as a political economist,)—whilst preserving its substance intact; (in the language of jurisprudence)—(AU.)

This may be termed *capability*—(TR.)

were done, we should have plenty of trees to fell in one year, and only a few in the *succeeding one*, for *natural seedlings* are far from appearing and growing with regularity. The fellings are, therefore, made by volume, and we should estimate the cubic contents of all the standing timber in the current periodic block, and divide this amount by the number of years of the period.

Ia contains	..	..	3,300	cubic métres.
Ib "	..	..	2,820	" "
Ic "	..	..	5,880	" "
		Total,	12,000	" "

The annual felling will be $\frac{1}{20}$th or 600 cubic métres. It is clear that if we fell annually 600 cubic métres, we shall be certain not to exceed the *possibilité* or *capability* of the forest,* for the trees standing in the first periodic block at present contain this volume, and as they will remain standing on the average for half the period, *i.e.*, during 10 years, it would be but fair to add the increment of the standing crop during 10 years to the actual cubic contents, 12,000 cubic métres.

I will at once admit that this increment is always very difficult to determine, and that it would be much more prudent to fix the *annual yield* at only the $\frac{1}{20}$th part of the volume of the standing crop, estimated at the time the working scheme was framed.

The increment will form a reserve to set against the diminution of the volume which might arise from errors in estimating and cubing ;† we need never lose sight of it, as we can always verify from time to time the volume still to be felled, and by dividing it by the remaining number of the years of the period, can calculate again the amount of the annual felling. This simple operation, which is called *revising the capability*, can be done, for instance, at each decennary.

As regards the order of the fellings, it must be prescribed by Nature, and by the forester's intelligence : nothing is more capricious than the way in which natural seedlings are produced, and all that we can do is to suggest the order for commencing the fellings, which is done in the simplest manner by the letters *a*, *b*, *c*, in the *table of fellings*.

* One cubic métre is nearly 36 cubic feet—(TR.)

† Windfalls and dead trees, which occur in the first periodic block, and generally, in the compartments which furnish the capability of the fellings by volume, are included in the annual yield. Those which come from other parts of the forest, are not included in this estimate, since they have not been considered in calculating the capability—(AU.)

2ndly. Secondary produce.—The principal products are thus worked out according to volume, and are classified in this manner in the special table of fellings, as opposed to the thinnings which are made by area. These latter, which are often called in a general way, *improvement fellings*, differ in character, with the age of the timber, and consequently with the age-classes of the standing crops in the periodic blocks. In young forest-growth the number of stems which become suppressed, and die, is naturally greater than in older ones, and they must therefore be thinned more frequently than the latter. In the case of timber 80 to 100 years' old, classed in the second periodic block, it is often useful to thin rather heavily, in order to allow trees destined to give seed later on, to increase their crowns, and thus to become fit for producing it: the thinning then takes a new character, by which we can distinguish it under the names of *final thinning*, or *preparatory regeneration felling*.

The proprietor who can devote all his energies to the good management of his forest, will endeavour to repeat these delicate operations frequently, and to assign to them a rotation conformable to their various requirements; but in a very important undertaking, such as the administration of Government forests, it will suffice, that the rules for thinnings should be adapted to the principal requirements of the standing crop, and to the main features of their culture.

Two methods are in use—

1st. In the former, each of the four periodic blocks about to be thinned, forms a succession of fellings, which must be effected throughout the periodic block once, or twice, during the period. Thus in periodic blocks II. and III., $\frac{1}{20}$th of the area, or $2\frac{1}{2}$ acres a year, will be thinned annually. In IV. and V., $\frac{1}{10}$th of the area, or 5 acres a year, will be thinned, thus going over each block twice during the period. A similar regularity to that of coppices can even be followed, by dividing each periodic block into ten parts, and making fellings every other year in II. and III., and every year in IV. and V.

This plan has the great advantage of securing a regular succession for the thinnings, and assisting in maintaining a steady annual yield, by furnishing yearly thinnings of the same nature, *i.e.*, made in similar standing crops in every periodic block. The only fault we can find with it, is, that in forests of small extent, it furnishes inconsiderable fellings, which give little produce, are difficult to sell, and require too much supervision.

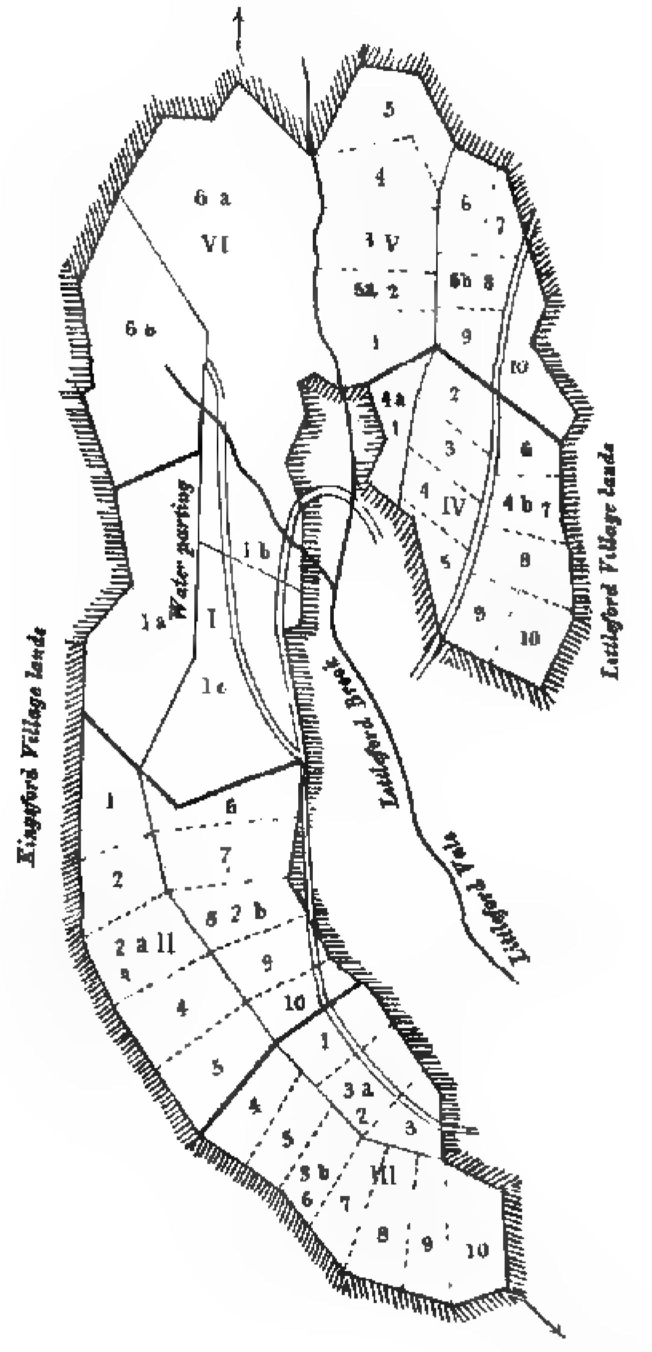
The special table of fellings for the first period will, in this case, be drawn up as follows :—

Special Table of Fellings for the first period, (1880-1899.)

Compartments.	Area, in acres.	State of standing crop.	Ages in 1880.	Nature of operation.	Fellings by area.	Remarks.
		A. *Fellings by Volume.*				
I*a*,	15	High forest of oak with seedlings,	130	Regeneration fellings,	..	Volume to be exploited 12,000 c. m. at 600 c. m. per annum.
I*b*,	12½	High forest of beech with seedlings, ..	110	Do.,	..	Special works to be made during this period.
I*c*,	22½	Mixed high forest, ..	105	Do.	..	
		B. *Fellings by Area.*				
II*a*,	25	Young high forest, regular, ..	90	Final thinning,	Five acres every other year (even numbers).	Second-class forest road in compartments I*a*, I*b*, I*c*, with a bridge over the Littleford brook.
II*b*,	25	Do., ..	80			
III*a*,	12½	High poles,	80	2nd thinning,	Five acres every other year (odd numbers).	
III*b*	36½	Do., ..	70			
IV*a*,	6¼	Poles, regular, ..	50	1st thinning,	Five acres per annum.	
IV*b*,	43¾	Do., ..	40			
V*a*,	25	Saplings and poles,	40	Cleaning,	Do.	
V*b*,	25	Do., ..	30			

The Map of the Forest is given on the succeeding page.

AMÉNAGEMENT DES FORÊTS.



Litho. T. C. Press, Roorkee. Thos. D. Bona, Supdt.

2ndly. In the other method, the four periodic blocks which are to be thinned, are treated as a whole, and their united area of *200 acres forms a succession of fellings for the time chosen* for the rotation of the thinnings. It will always be an advantage, as in the first method, to choose the length of the *period* for their rotation; thus the thinnings will continue for 20 years, at the rate of 10 acres a year, and will be carried out for five years in each periodic block. The nature each thinning should take, will be indicated by the periodic block in which it is to be made, and the rotation chosen for the compartments, is such as to suggest to the foresters the proper mode to be adopted. To take an instance, in compartment IV*a*, any ordinary forest guard would know that he was dealing with a thinning in a fourth periodic block, even if he had no map, and were ignorant of the working-scheme of the forest.

In the following period, *i.e.*, in 1900, the second periodic block will come under regeneration, and will be replaced in the succession of thinnings, by the sixth periodic block, so that the total number of 200 acres may be maintained; thus the thinnings will recur every 15 years, if we wish to continue them according to the order of the periodic blocks,—this being a mean, between the interval suitable for young and more mature timber,—or every 20 years, if we are careful to commence the thinnings in 1900, in the periodic block just entering this succession of fellings, in the place of that which is coming under regeneration. We can then, in each period, make our thinnings recur at intervals suitable to cultural requirements, and introduce into high forest management the simplicity and regularity of coppice, by dividing each periodic block into five equal parts.

The only drawback to this method, is that of not furnishing a steady annual yield, since thinnings in II. and III., are much more productive than those made in IV. and V., which are generally mere cleanings; but its simplicity has often caused its adoption in important State and Communal forests, where an unequal annual yield is generally compensated for by fellings in other working circles.

To sum up, we may say that the choice between the two methods depends on the area of the forest in question; the former being preferable, when there is no chance of its resulting in too inconsiderable fellings.

The following is the special table of fellings prepared according to the second method of thinnings:—

Compartments.	Areas, in acres.	State of standing crop.	Ages in 1880.	Nature of operation.	Fellings by area.	Remarks.
		A. Fellings by Volume.				
Ia,	15	High forest of oak with seedlings,	130	Regeneration fellings.	..	
Ib,	12½	High forest of beech with seedlings, ..	110	Do.	..	
Ic,	22½	Mixed high forest, ..	105	Do.	..	
		B. Fellings by Area.				
IIa,	25	Young high forest, poles and saplings, ..	90	Thinnings,	10 acres per annum.	
IIb,	25		80			
IIIa,	12½		80			
IIIb,	36¼		70			
IVa,	6¼		50			
IVb,	43¾		40			
Va,	25		40			
Vb,	25		30			

To return to our forest—

There are then three established sub-divisions for forests: *periodic blocks; compartments; thinning plots.*

The first are marked out permanently on the ground; they are the great divisions of the forest: the other two are only sub-divisions of the periodic blocks, and the question arises, whether or not it will be necessary to mark them out on the ground.

Regarding this it is difficult to lay down an absolute rule.

In the case of the first periodic block, there need be no hesitation; the boundary lines of the compartments should always be marked out on the ground, since it will always be useful to know, at any time, the cubic contents of the timber which they contain, and for this purpose a special register should be kept up for each of them. In the case of the other periodic blocks, we may have forests regular and homogeneous enough to allow of the suppression of the compartments, which have served in the inventory of the forest, and we may then mark out on the ground the boundary lines of the thinnings. The boundary lines of the compartments will then only remain on the maps for the purpose of explanation, whilst the lines of the thinnings will be marked out on the ground by little boundary pillars or ditches. But this will seldom happen, for in reality we have only to do with irregular forests, where the *raison d'être* of compartments must be attended to. They were first demarcated to enable us to analyse the forest and estimate its resources, and have besides the definite object of separating portions of the forest, where the situation, and the character of the vegetation will always necessitate special treatment for the standing crops. Thus they have the double character of being analytical as well as cultural divisions. As soon as we have agreed upon the general working-scheme, we should suppress compartments which have only served for analysis, and only preserve those which ought to be maintained on account of permanent peculiarities. One should then, as a general rule, *mark out the compartment lines on the ground*. As for the thinnings, *their boundaries will be drawn on the forest map*, giving them the most suitable shape for working, according to the contour of the ground; we thus prevent loss of time, and uncertainty regarding their proper position, which might otherwise be an annual source of inconvenience. In practice, we may even slightly modify the absolute rule of sub-divisions into equal areas, which we have given in the explanation of the two systems of thinnings; by making use of the compartments, grouping them, or sub-dividing them, so as to include the annual thinnings within their boundaries, even if small differences of area occur. These areas are then entered in the special table of fellings opposite to the years in which they should be felled. In this way we can completely satisfy one of the most essential conditions of a good working-scheme, which is, never to contravene, and always to favor the application of the rules of forest culture.

The reserve.—I have already said, that it is advantageous for certain classes of proprietors, to place a portion of their capital in reserve, and that forests offer great facilities for such a measure. The high forest system in this respect offers more facilities than that of coppice; we could, in fact reserve a portion of the forest for supplying unforseen necessities; but it would

be much better to deduct a portion of the annual yield; for once the reserve has been exploited, we might have to wait, often for a very long time, until nature has restored it. But by making a deduction of 10, 15, 25 per cent. from the revenue, we carry out the most essential condition of a reserve, *i.e.*, of always including exploitable timber, and of being always at our disposal.

Amongst the two components of the revenue of a high forest, it would be quite useless to deduct anything from the secondary produce of the thinnings, for they have a distinctly cultural object, which must never be lost sight of, and pecuniarily, they are too little productive to be useful for this purpose. The reserve must be taken from the produce of the principal fellings: from the 12,000 cubic métres destined to furnish the principal *fellings, we will deduct* 25 per cent., (provided unforseen wants are set at this figure,) *i.e.*, 3,000 cubic métres. The remainder, 9,000 cubic métres, will furnish an annual yield of 450 cubic métres.

The 3,000 cubic métres of the reserve will always be at the command of the proprietor, provided the regeneration of the first periodic block be assured; they will furnish him with a surplus stock, of which the average is 150 cubic métres annually, and which may be exploited within the 20 years of the period, *with the proviso* that we should constitute a similar reserve, when we commence felling the second periodic block in 1900.

Register of the working-scheme.—In following the table of fellings exactly, the proprietor will always be certain that he is not tampering with his standing crop, which may be called the mechanism of his forest; but it nearly always happens that the requirements of natural reproduction hasten or retard the fellings in such and such a compartment; that thinnings are not made, because they would give an insignificant yield, or that fellings, more or less severe, are made in the reserve. All these circumstances create for high forests, much more than for coppices, the urgent necessity of keeping an exact account of the state of the forest capital.

The register of the working-scheme will be kept up as in coppices, but a separate column will be set aside for each *succession of fellings,* which the working-scheme prescribes. A record will thus be made for each compartment, and the cubic contents taken from the reserve will be written in red ink, to prevent confusion.

The following is a register of the working-scheme for the forest which has already served us as an example, supposing that the scheme were framed in 1880 :—

Register of the Working-Scheme. First period, from 1880-1899.

A. *Fellings by Volume.*

Periodic blocks.	I				Fellings.		
Compartments.	Ia.	Ib.	Ic.	Total.	Ordinary.	Made in the reserve 3,000 cubic metres and in the increment.	Remarks.
Cubic contents to be felled.	c. m. 3,300	c. m. 2,820	c. m. 5,880	c. m. 12,000	c. m. 9,000		
1880, ..	451	..	..	451	451	..	
1881, ..	450	210	235	895	445	450	
1882, ..	150	..	300	450	450	..	
1883, ..	..	..	441	441	441	..	
1884, ..	20	{ 40 403	} 390	853	450	403	
1885, ..	449	..	..	449	449	..	
....	..	..	..	..	..	..	

B. *Fellings by Area.*

Periodic blocks.	II.		III.		IV.		V.		Total.	Fellings.		Remarks.
Compartments.	IIa.	IIb.	IIIa.	IIIb.	IVa.	IVb.	Va.	Vb.		Ordinary.	In the reserve.	
Areas to be felled, in acres.	26	25	$12\frac{1}{2}$	$36\frac{1}{2}$	$6\frac{1}{4}$	$43\frac{3}{4}$	25	25	$198\frac{3}{4}$			
1880, ..	$8\frac{1}{3}$	..	..	..	..	..	..	..	$8\frac{1}{3}$	$8\frac{1}{3}$	..	
1881, ..	$8\frac{1}{3}$	..	..	..	..	..	..	..	$8\frac{1}{3}$	$8\frac{1}{3}$	..	
1882, ..	$8\frac{1}{3}$	..	..	..	..	..	..	..	$8\frac{1}{3}$	$8\frac{1}{3}$	..	
1883, ..	..	$12\frac{1}{2}$	..	..	..	..	..	..	$12\frac{1}{2}$	$12\frac{1}{2}$	..	
1884, ..	..	$12\frac{1}{2}$	..	..	..	..	..	..	$12\frac{1}{2}$	$12\frac{1}{2}$	..	
1885, ..	..	..	$12\frac{1}{2}$	..	..	..	..	..	$12\frac{1}{2}$	$12\frac{1}{2}$	..	
1886, ..	..	..	..	$8\frac{1}{2}$	..	..	..	..	$8\frac{1}{2}$	$8\frac{1}{2}$	..	
....	..	..	..	..	..	..	..	..	..	..	..	

These figures show that in 1881 460 cubic mètres were exploited in the reserve in I*a*, and 445 cubic mètres from ordinary fellings, in two lots in I*b*, and I*c*. In 1882 the ordinary felling was formed by two lots, 150 cubic mètres in I*a*, and 285 cubic mètres in I*c*; in 1883 a single lot of 441 cubic mètres in I*c*; in 1884, 408 cubic *mètres from the reserve, were exploited in Ib.* The ordinary felling consisted of 20 cubic mètres of windfalls in I*a*, 40 cubic mètres in I*b*, and by a lot of 390 cubic mètres in I*c*.

Regarding the thinnings, the average of the annual fellings is 10 acres; but we may notice the method chosen of including the fellings within the compartment limits, so as to avoid having the annual felling carried on in two compartments at once, without accelerating or retarding them more than if only exactly 10 acres had been exploited annually: thus compartment II*a*, of 25 acres has furnished two fellings of 8½ acres, and one of 8⅓ acres, for the three years 1880, 1881, and 1882; compartment II*b* of the same area, has only been divided into two fellings of 12½ acres each, for 1883 and 1884, so that the 50 acres have been gone over in five years, as if we had made five fellings of 10 acres each, &c.

CRITICISMS ON "NOTES FOR A MANUAL OF INDIAN SYLVICULTURE."

I HAVE been favoured with further criticisms on my Notes by several gentlemen, but as they would take up too much space in a single number of the "Indian Forester," I cannot help publishing them in instalments in the order in which they were received.

I must also give up printing the criticisms in italics, as they are very long, and whole pages of such type look very ugly. Smaller ordinary type with inverted commas to distinguish the criticisms from my own replies seems to me the best thing to adopt.

MR. SMYTHIES.

"*Page 109, III (d).*—The young plants and trees of *Pinus longifolia* possess a thick corky bark which protects them from fire admirably: it is evident that those individuals have survived which possessed the thickest bark, as fires rage annually in *Pinus longifolia* forests. This might be mentioned perhaps somewhere, as so much is said about the struggle for existence."

Yes, I will mention this in connection with the fact, which I have omitted to specialise, that the greater power of resistance enjoyed by the older trees to damage by fire, frost and drought is often due to the greater thickness of their bark. I will also add at the top of page 116, that the vitality of dormant buds depends in a great measure on the thickness of the covering rhytidome.

"*Page 126, IX (b).*—With regard to deodar, you cannot say 'with the consequence that seed fails on an average *in one year out of four*.' First of all, it would be nearer the truth to say that seed is produced on an average in one year out of four. It has been proved in Jaonsar that deodar seeds freely *one year* in three on an average, both as regards the whole crop and individual trees. You can nearly always find some seed *somewhere*, but that does not imply that a particular seed-bearing tree produces seed every year. Secondly, it is *extremely doubtful* that the 13 or 14 months which elapse from the appearance of the flower-buds to the maturation of the seed are the *cause* of the failure of seed two years out of three, or even 'one out of four' as per Notes. This might have something to do with it if flower-buds appeared every year; but according to my experience, flower-buds do not appear every year, nay, are totally wanting in those years which are succeeded by a year of no seed (from October of one year to November of the next). The seed fails because there are no female flowers formed; but why this occurs sometimes I do not pretend to say."

The expression 'in one year out of four' is evidently an oversight: it ought to have been 'three years out of four.' I was

contrasting the more frequent seeding of the Himalayan firs with the rarer production of fruit in the deodar. But this is only a side question. If Mr. Smythies is right, and I have every reason for admitting his high authority, I must omit altogether the passage 'Thus between the appearance..................during the mildest months.' Would Messrs. Bagshawe, Moir, Eardley-Wilmot and others kindly favour me with their own experiences?

"*Page 127, IX (d).*—Speaking broadly you may say of *Quercus dilatata* and *semecarpifolia* that they ripen their acorns in the *middle* of the rains; but more strictly it is, the latter at the *beginning*, the former at the *close* of the rains. The moral is very much the same in either case, *i. e.*, in whichever way you put it."

Where I have had an opportunity of observing these two species, the latter ripens its fruit in August, the former about a month later. August-September, may fairly be called the middle of the rains. But to leave no room for objection, I will gladly alter the words 'in the middle of the rainy season' to 'during the full prevalence of the South-West Monsoon.'

"*Last para. of IX (d), page 127.*—This does not apply, as it stands, to those seeds which germinate in the Himalayan spring—deodar, *Pinus longifolia*, silver and spruce firs, &c. The sentence, as it stands, implies that all seed germinates in the rains: the spring, after the snows have melted, is a more favourite time for Himalayan trees."

I am very much obliged to Mr. Smythies for pointing out this absurd oversight on my part. I think the addition of the following closing sentence to the paragraph in question will supply the omission:—

'The preceding remark does not of course apply in the inner Himalayas to a great many kinds of seed which fall about the beginning of winter. The majority of such seeds germinate in the spring when the snows are melted, or, where snow does not lie on the ground, during the spring rains.'

"*Page 130, XII, last para.*—Deodar cannot be acclimatised in England, not owing to late frosts in the spring, but owing to the intensity of the frost in occasional winters, *e.g.*, 1880-81 and 1879-80. The deodar goes on happily enough for several years, not minding late frosts in the spring; and then a severe winter occurs which kills it. On this point I give below the testimony of Messrs. James Backhouse and Sons, the large nurserymen at York":—

'The deodar, so far as we have seen, always suffers severely (and often fatally) with a frost of great intensity—say, thermometer at or below zero *(Fahrenheit?)*.'

I am much obliged to Mr. Smythies for the above facts. But they do not in any way affect what I have said: by Northern Europe I of course mean the northern portions of the European

continent. Great Britain and Ireland, from their insular position and full exposure to the warm gulf stream, enjoy a comparatively mild climate.

CAPTAIN WOOD.

"You define Epicorms as 'the twigs and the branchlets that develop on the boles of trees when they are suddenly exposed to the light;' a few lines above you say, 'the length of the stem of a tree under its branches is called its bole.' Now Epicorm means 'on the stem,' so that I think the word 'bole' should be used with whatever word it is accompanied. In your reply to Mr. Trimen, you say that 'stem shoots may be situated anywhere in the interior of the crown:' the nature of the shoots that grow on the bole is that of a sucker, and I would therefore propose calling the '*branches gourmandes*,' 'bole-suckers,' and the twigs on the bole, 'bole twigs': in Indian forests these bole twigs are not always caused by the sudden admission of light, but often from damage done by fire when the tree is young. Suppressed branches that appear on the bole and have twigs on them might be called 'bole branchlets'; a 'bole branchlet' is often what was formerly the leading shoot of a young tree which became damaged and pushed aside by a shoot (now the bole above it) which took its place."

'Epicorm' being a new word, I see no reason for insisting on its being made to mean a branch on *any* part of the stem, because *kormos* is the Greek for 'stem.' I think I am quite justified in limiting it to the twigs and branchlets which develop on that part of the stem, which I have called the 'bole.' If the necessity ever occurs for specialising the fact that the epicorm in question is a twig or branchlet, we have only to use the derivative adjective *epicormic* as a qualifying word. Captain Wood's proposed employment of the word 'sucker' is not defensible, since a sucker is necessarily a subterranean shoot. I see no good in adopting the special term 'bole branchlet.' Captain Wood's remarks have, however, made me perceive the insufficiency of my definition, which I would accordingly modify thus:—

'An epicorm is any twig or branchlet situated on the bole of a tree.'

Thus our word 'epicorm' will include not only what the French call *branches gourmandes* and the Germans *Wasserloden*, but also all unhealthy developments of twigs and branchlets on the bole, which are so commonly to be seen in our irregular forests, especially in those of sál.

"For 'social' why not use the word 'associative'? The word 'associated' is often used with the word 'trees' to express trees of a species which naturally grow in the company of another species or of several different species."

This is a very good suggestion; but I think that the word

'sociable,' which I have proposed in the January Number (page 14), is better for two reasons. In the first place it is in current everyday use, and, in the second place, we obtain from it the equally current noun 'sociability.'

"*Evergreen* and *deciduous*.—*I think we want some word between* the two. Grigor (a Scotch authority on practical arboriculturist) uses the word 'sub-evergreen,' and I think we want some such word, to describe trees which, according to your definition, are deciduous, but are never quite bare owing to the new leaves coming out while the old ones are being shed, as sál, *Eugenias*, *Schleichera trijuga*, *&c.*, generally, &c. In the first and second lines of page 130, you mention 'the sál which is all but an evergreen,' practically it is an evergreen, and though we want to be as exact as we can, we must not, on the other hand, drop the use of accepted words, otherwise we might object to *evergreen* as not being strictly correct, and we might object to 'evergreens' being classed separately from deciduous trees, as most 'evergreens' are really deciduous, only not in the sense laid down by you.

"When treating of climbers (page 39, lines 27 and 28) you remark, 'and indeed the largest of them are found in dense evergreen forests.' Are you using the word 'evergreen' in its strict or general sense? I have seen specimens of *Bauhinia Vahlii* with stems about 50 inches in girth breast high, and covering over a quarter of an acre of sál trees 50 or 60 feet high. These are large enough specimens to do a large amount of damage, and I should like to know in what evergreen forest there are larger ones. Should on enquiry *it be found that* the largest creepers are in *deciduous* forest, it will be a greater reason for adopting a word which will define trees that are almost evergreen. I propose the word *quasi-evergreen.*"

My answer to this objection would carry me beyond the space allotted for this paper, and I, therefore, reserve it for the next issue of the "Indian Forester."

E. E. FERNANDEZ.

A PERIODICAL RAIN-GAUGE.

THIS instrument is designed to give at one reading the whole rainfall for a year, or any shorter period. It is intended especially for use in forests, or in inaccessible localities which cannot be easily visited more than once a year in the fair season; though it may be found useful also, as a registering instrument, to check the totals of rainfall taken in the ordinary manner by unskilled observers, such as the clerks in a Revenue office. It gives at one reading rainfalls up to 100 inches.

Description of instrument.—The last form which I have adopted consists of three bottles standing in a metal case, very like the half of a small wooden barrel, the sides of the zinc case at the

height of the shoulders of the bottles are cut into teeth at the edge, so as to allow of free ventilation under the metal collar which surrounds the top of the three bottles. The object of this metal collar and of the metal case in which the bottles are placed, is to shield the bottles from the unequal incidence of direct sun-light, and to preserve each bottle as far as possible at the same temperature. The metal casing is so arranged, that while the wind has free access to each bottle, slanting sun heat is received on the double metal casing, and conducted to every part of the instrument alike. A further precaution, but one not practicable in most situations in warm countries, on account of white ants, would be to interpose a felt lining between the bottles and the metal casing. Where the situation admits of it, greater accuracy in the evenness of the evaporation would probably be secured by taking the three bottles out of the case and placing them apart from one another, at such a distance, that the shadow of one would not fall on the shadow of another; for common bottles of thick blue glass well coated with dust throw a tolerably deep shadow, and absorb the greater portion of the heat from direct sun light passing through them. The broad metal collar has a slope of more than 45° with the horizontal, so as to obviate the chance of rain splashing up drops from the surface of the collar into the funnels. As most people are aware, heavy drops of rain, notably tropical rain, will, from a smooth horizontal surface, splash up vertically to a height of above a foot. For the same reason, *i.e.*, to prevent vertical splash, the cap of the evapometer is made pointed, and placed at a level lower than that of the mouths of the funnels. Two bottles fitted at the neck with funnels, constitute the rain-gauge proper of the instrument: the third bottle, instead of a funnel, has a cap like an inverted funnel with the small end closed. This is the evapometer. Under the cap of the evapometer, so placed that no rain can enter it, is a small hole of the same size as the aperture at the small end of the two funnels which receive the rain, so that the circulation of air in each of the three bottles may be the same. The principle of the instrument is, that evaporation proceeds equally in all three bottles, and that the total rainfall, at the end of any period, equals the rain water found in the first two bottles, plus the loss from evaporation as registered in the evapometer. This will perhaps be made clearer by an account of the instrument in its simpler form as it was first used in Mysore. The following is taken from the "Indian Forester" for January 1882, page 223 :—

The gauge consists of two cylinders of sheet zinc—one constructed like an ordinary gauge, except that it is longer, being of a length to retain the maximum quantity of rain which might fall between any two observations; and the second similar to the first, except that it is much shorter, and adapted to give the

measure of the evaporation only taking place in the first cylinder. For this purpose, the second cylinder is like the first, but furnished with an umbrella-shaped cap, which excludes all rain while permitting the free circulation of air to the funnel. Placed in position, the conditions of the two cylinders are identical, except that rain is admitted to the first cylinder, and excluded from the second; evaporation goes on equally in both. The first cylinder gives rainfall minus evaporation; the second evaporation only. The diameters of the cylinders are such as is convenient for reading with a graduated glass measure, and of a convenient size with regard to the height; mine are 8 inches. To set the instrument; a known quantity of water is placed in the first cylinder A, say one inch, to ensure constant evaporation till the first shower falls; at the same time the second cylinder B is filled with water. To read the instrument; the rainfall since last observation equals the depth of water in the first cylinder A, plus the loss by evaporation read from the second cylinder B. The height of water in each cylinder can be read approximately, and very rapidly, with a graduated slip of zinc painted black with white figures. Black or dark grey paint shows the water lines best.

When greater accuracy is required, or if the cylinders are badly made, the water in each is measured in the usual way, with a graduated glass vessel.

The tops of both cylinders are locked with brass letter padlocks. Both cylinders are imbedded in a mound of stones, earth, &c., turfed over, first, to prevent excessive evaporation, from solar heat; secondly, to prevent the instrument being disturbed. Any malicious tampering with the instrument to make the rainfall appear less, becomes then discoverable.

In the improbable case of any one being interested in endeavouring to make the rainfall appear more, it would be easy to supplement each large cylinder, with two or three smaller ones, with known small diameters, as checks, in which case any one desirous of tampering with the gauge by adding water would have to do so in the ratio of πr^2 for each cylinder! The advantages claimed for this instrument, are that it enables one to obtain a knowledge of the total rainfall, accurately within a tenth of an inch, and of the total yearly evaporation, under the conditions—these two factors being the important ones to tree life.

In its present form the instrument is more compact, and one lock secures it, so that nothing can be removed, nor can the instrument be opened without unlocking it. Glass bottles have been substituted for vessels of copper or zinc, it being found in practice that the oxidation and consequent liability to leak of metal

vessels in any form, is a fatal objection to their use, when water has to be stored for a long period.

The receiving area of this rain-gauge is now 6·5450 square inches, or one-third the receiving area of the ordinary Symon's gauge, which has a receiving area of 19·6350 square inches, with a diameter of funnel of 5 inches. Thus this rain-gauge requires no special measuring glass, the figures given by the ordinary measuring glass for a 5 inch gauge, being multiplied by 3 when the instrument is being read. In the periodical rain-gauge the receiving area of (6·5450 square inches) is broken into two nearly equal halves, two funnels taking the place of one. Of the two funnels, one is slightly below, and one slightly above, 2 inches in diameter. The larger funnel, 2·09426 inches in diameter, has a receiving area of 3·44474 square inches: the smaller funnel, 1·98680 inches in diameter, has a receiving area of 3·10026 square inches. These figures are so arranged that the receiving area of the smaller funnel is $\frac{9}{10}$ the receiving area of the large funnel, hence the rainfall measured from the bottle with the smaller funnel equals the rainfall measured from the larger funnel multiplied by 0·9. The object of this division of the receiving area is threefold :—*1st*, To test the readings of the instrument. The rain-gauge being locked up and left by itself for a year is very liable to be tampered with. Malicious or stupid persons may pour in water or earth; the droppings of birds or trees may foul the water (which influences the evaporation) or stop up one of the funnels. Unless the readings from the two bottles satisfy the test that the lower reading is $\frac{9}{10}$ of the higher reading, it may be assumed that something is wrong: and again, the instrument only requiring to be read once a year, the services of a skilled observer would ordinarily be available for this purpose, but on emergencies, when it might be necessary to employ an unskilled observer, his readings could be checked by applying the test to his returns.

2ndly. Circumstances may arise in which, through an accident, the reading from one bottle may be vitiated, and at the same time, there may be no reasonable doubt, that the reading from the remaining bottle is correct. In this case the rainfall can be calculated from the reading of the single bottle instead of interpolating, in order to complete a series of observations.

3rdly. By distributing the rainfall in two bottles, very large bottles which are costly, cumbersome, and difficult to replace if broken, are avoided. Bottles containing half a gallon, or 4½ pints, may be purchased in all large commercial towns in India for a few annas. But enquiries made in Calcutta, Bombay, and Madras, from various sources, have failed to procure bottles larger than this. I have obtained empty stoppered gallon bottles direct from England (the Army and Navy Co-operative Stores)

at a cost of about Rs. 3 each. Unstoppered bottles would serve equally well; and, imported in any large quantity, would probably cost under one rupee each. Gallon bottles are necessary for rainfalls which exceed 50 inches per annum. A gallon contains 10 lbs. of distilled water, or 277·274 cubic inches. The bottle provided with the larger funnel will be full of rain water first, and thus the capacity of the gauge to register rain is, with gallon bottles, 277·274 ÷ 3·44474 (the receiving area of the larger funnel) = 80·492 inches depth of rain. To this figure, in reading the instrument, is added the loss by evaporation from the evapometer, multiplied by 2; the evaporation of course varies with the climate; and some allowance may usualy be made for bottles holding more than their stated capacity when filled up to the rim of the neck. So that the periodical rain-gauge (large size, with gallon bottles) may be reckoned on, under ordinary circumstances, to register rainfalls up to 100 inches. For dry climates, where the rainfall never exceeds 50 inches a year, the small compact instrument made with half gallon bottles is sufficient. The cost of this instrument made of stout sheet zinc, with bottles purchased in the bazaar is Rs. 5. The cost of the larger instrument, made up in Bangalore, of sheet zinc with gallon bottles procured from England, was Rs. 13; made of sheet copper in Madras with gallon bottles from England, the cost of the large size instrument was Rs. 25. It is not practicable to make the funnels of sheet copper, and the vessels to hold the bottles, of zinc, on account of the galvanic action which is set up speedily corroding the zinc. Zinc does not look so neat as copper, nor is it as strong and lasting, but, remembering that copper is a precious metal to the poorer classes, and that this rain-gauge is designed to be left unprotected in remote localities for a year at a time, it is evidently safer to have the gauge constructed of zinc than of copper. Tin should not be used at all on account of its liability to rust.

For short periods, or for a small annual rainfall not exceeding 17 inches for the half gallon bottles, or 33 inches for the gallon bottles, it is useful (where every cent of rain has a relative value) to have a second set of funnels with a receiving area the same as that of the standard 5 inch gauge. These two funnels have receiving areas of 10·33421 square inches, and 9·30079 square inches with corresponding diameters of 3·627385 inches, and 3·44124 inches. With these funnels the instrument is read in the same way as with the 2 inch funnels, except that the figures, on a measuring glass made for a 5 inch gauge, must not be multiplied by three, the instrument itself being now a 5 inch gauge.

To set the instrument.—To set the instrument, clean the bottles and put in fresh water (as pure as can be conveniently procured) in the following quantities. With the measuring glass, measure

in water into the evapometer, equal to about half the yearly rainfall (or about half the rain which may be expected to fall during the period for which the gauge is set). Enter this figure in a note book, or in the form annexed. In each of the bottles with funnels, measure in a few inches of water, enough to allow (approximately with a margin) for evaporation till the rainy season begins. Enter this figure in the note book, and lock up the instrument before leaving it. Padlocks of brass must be used to avoid rust. The large pin must be passed through the metal casing on both sides, and through the ends of the small chains hanging down from the funnels, and from the evapometer cap. The pin is secured by a padlock at the small end, and fastens together the various parts of the instrument.

To read the instrument.—Unlock the padlock, withdraw the pin, and lift off the broad *metal collar with its attached funnels* and evapometer cap. Measure the contents of each of the three bottles separately, and enter the figures in inches and cents. The calculation of the total rainfall for the period is then easily made in the following form :—

To set the instrument.

Water left in each funnel bottle, ...	=	inches.	
Water left in the evapometer bottle, ...	=	inches.	

To read the instrument.

Water found in the larger funnel bottle,	=	inches.	cents.
Subtract the water left as above in this bottle when the instrument was set, ...	=	inches.	
Rain water in bottle, ...	=	inches.	cents.
Water found in the smaller funnel bottle,	=	inches.	cents.
Subtract the water left as above in the bottle when the instrument was set, ...	=	inches.	
Rain water in bottle, ...	=	inches.	cents.
Water left as above in the evapometer, ...	=	inches.	
Subtract the water now found in the evapometer, ...	=	inches.	cents.
Loss by evaporation from the evapometer,	=	inches.	cents.
		× 2	
Evaporation from both bottles, ...	=	inches.	cents.
Add the rain water from both bottles,	{	inches.	cents.
		inches.	cents.
Total rainfall, ...	=	inches.	cents.

D. E. Hutchins,

Deputy Conservator of Forests.

NOTES ON THE CULTIVATION OF HOT SEASON NATIVE VEGETABLES.

THE variety of vegetables which can be grown during the hot season, that are agreeable to the European palate, is very limited. The following remarks on the cultivation of a few of them, that are most generally relished, may be acceptable to those of your readers who take a personal interest in the doings of the *máli*, in the kitchen garden. As a rule, he is allowed to have his own way in cultivating hot and rainy season vegetables, and his master has to accept what he is pleased to bring. *Mális* have a trick of filling up the garden for their own benefit with varieties of vegetables they well know their masters will not eat. A little time may, therefore, be very profitably spent in noticing his doings at this season.

VEGETABLE MARROW or SQUASH.—In Upper Bengal and in the North-West Provinces this vegetable should be sown in the end of February, and all through March. It succeeds best in ground that has been well manured in the beginning of the cold season for a turnip or cabbage crop. If an empty plot is not available and the previous crop not all used, the remains may be allowed to stand. The vegetable marrows can be sown in the vacant spaces, that are sure to be found in such a plot in the months of February and March. Holes 2 feet wide and 18 inches deep should be dug, and the soil thrown back well mixed with old cow or stable manure. If old manure is not at hand, do not give any, as fresh manure will do more harm than good. In such a case it is much better to depend on the unexhausted manure which was given for the previous crop. Three or four seeds should be sown in each hole, and if they all germinate, only one of the strongest should be allowed to remain. Water should be given twice a week until the ground is well covered, afterwards once a week will be sufficient. The leaves and flowers of this, and in fact all the Cucurbitaceæ, are much injured by the ravages of a small red beetle. Hand picking is the best remedy, and a slight sprinkling of wood ashes over the plants twice or thrice a week the next best. There are several English and American varieties. The most useful are Moore's vegetable cream, long fruited white, and long fruited green. They all succeed best if raised from acclimatized seed. If it is obtained direct from an English or American seedsman the yield is generally poor. A few of the best fruits should, therefore, be annually reserved for seed, for sowing in the following season.

KUKREE. *Cucumis utilissimus.*—This species of cucumber has fruits from one to two feet long. When in a young state they are covered with soft, downy hairs, and are then of a pale green colour. When fully ripe the colour changes to a brilliant

orange. It is a true hot season vegetable, and will not succeed in the North-West Provinces, at least during any other season. It should be sown in the end of February and any time during March. It prefers a dry loose open soil. A well drained plot should, therefore, be selected for growing it. After manuring, the ground should be laid out in beds, and three or four seeds sown in patches 3 feet apart. As with vegetable marrows, only one of the strongest should be allowed to remain if they all germinate. Water should be given once in ten days. If given too often the fruits turn yellow and fall off before they are ready for use. February sowings are ready for use towards the end of April. If a second sowing is made about the middle of March it will keep up the supply until the beginning of the rains.

KHEERA. *Cucumis sativus, var.* This is a variety of the common cucumber with small egg-shaped fruit, and is also a true hot season vegetable. In order to keep up the supply until the beginning of the rains, three sowings should be made, one in the end of February, one in the middle, and one in the end of March. It will succeed fairly well in any soil, but prefers a rich one. The ground should be laid out in drills, one foot apart. Sow the seeds along both sides of the drill, and if the soil is very dry water immediately after sowing. After they germinate, water every ten days. This vegetable, like the kukree, should not be watered too often.

KARAILA. *Momordica charantia, var.*—There are two varieties of this vegetable. The natives call one karaila and the other karaili. The former comes into use during the hot season, and the latter during the rains. The greatest difference between them appears to be the season when ready for use, as both are of the same appearance. The fruit is pointed at both ends, and covered with knotty protuberances. It has a very bitter taste, nevertheless it is much relished by some in curries. It should be sown in the end of February and all through March, in rich soil. The ground should be laid out in beds, and the seeds sown in lines 2 feet apart, and the same distance allowed between each seed. Water should be given twice a week until the ground is covered, afterwards once a week will be sufficient. The first sowing will come into use about the middle of April, and successive sowings made in March will keep up the supply until the beginning of the rains.

BRINJAL, or EGG-PLANT. *Solanum melongena.*—This is a popular vegetable with native gardeners, and one of the most useful. It is almost needless for me to describe its cultivation in detail, as they seldom fail to grow it to perfection. It can be brought into season at any time, and this quality causes it to be very valuable when other vegetables are scarce. It should be sown in October and November when required for use during

the hot season. It can also be sown in February and March, and will then come into use about the beginning of the rains. It will grow in any soil, but as with other vegetables, thrives best in a rich one. It should be sown in beds and transplanted when 2 or 3 inches high, in lines at a distance of 18 inches apart. It should be watered twice a week, and the soil frequently stirred around the neck of the plants. The fruits are very palatable when properly cooked, and no garden should be without them.

W. G.

LAC ON CAROB TREE.

TO THE EDITOR OF "INDIAN FORESTER."

SIR,—I send you in a little wooden box some twigs of a Carob tree in my garden which has suddenly been attacked, the branches being covered with little reddish dots and also with larger bubbles. All the branches attacked wither up; but the centre of the tree was not attacked and is alive. The appearance of the tree is as if a jungle fire had hastily passed over it, scorching up the outer branches. Is this the work of the lac insect? if so, it is, I think, a novelty on the Carob tree.

Or can it be only a disease? I did not know that lac killed the branches.

What the cause may be, I cannot say. There was a heavy rainfall in the rains, and a bush of hibiscus near was killed by the flood, but the water drained off and nothing that I noticed at the time happened to the Carob tree.

This may be of sufficient interest to mention in the "Forester."

B. H. B.-POWELL.

EDITOR'S NOTE.

The box containing the twigs has arrived. The dots and bubbles on the latter are due to the activities of the lac insect, *coccus lacca*. A similar occurrence took place in the Teliu Kherry gardens at Nagpur some years ago, when a splendid Carob tree, then in the full vigor of growth, was attacked and killed outright by the insects. Mr. Baden Powell's Carob tree might now be saved if the cells, incrusting the twigs and branches, be removed carefully with the fingers, so as not to injure the living bark underneath them.

R. T.

TO THE EDITOR "INDIAN FORESTER."

SIR,—It is a little tantalizing, where exactness is of consequence, to find people using such a loose expression as occurs in the January Number of the "Forester." An increment per acre per annum from the Changa Manga plantation is expressed in cubic feet (presumably piled) and in *maunds*. Will some one kindly tell me what is the local value attached to maund? Is it 80 lbs., or 42 lbs., or 25 lbs., or something near these values, or is it the Bombay maund of 28 lbs., which is the most rational, being the same as the English quarter? Molesworth gives fractional values for the maund, which I know are often neglected in practice.

K. H.

MYRABOLAMS.

TO THE EDITOR OF THE "INDIAN FORESTER."

SIR,—Will you or any of your readers kindly give me answers to the following questions:—

1. At what season of the year are myrabolams collected, and in what stage of growth?

2. Is anything done to the fruit before exportation, if so what?

3. Why is the fruit sent home, *i. e.*, why is the extract not sent home?

4. How much "cutch" can be obtained from a maund of myrabolams?

5. What is the system in force for getting the extract, and how long does it take to get all the extract out of a maund of myrabolams?

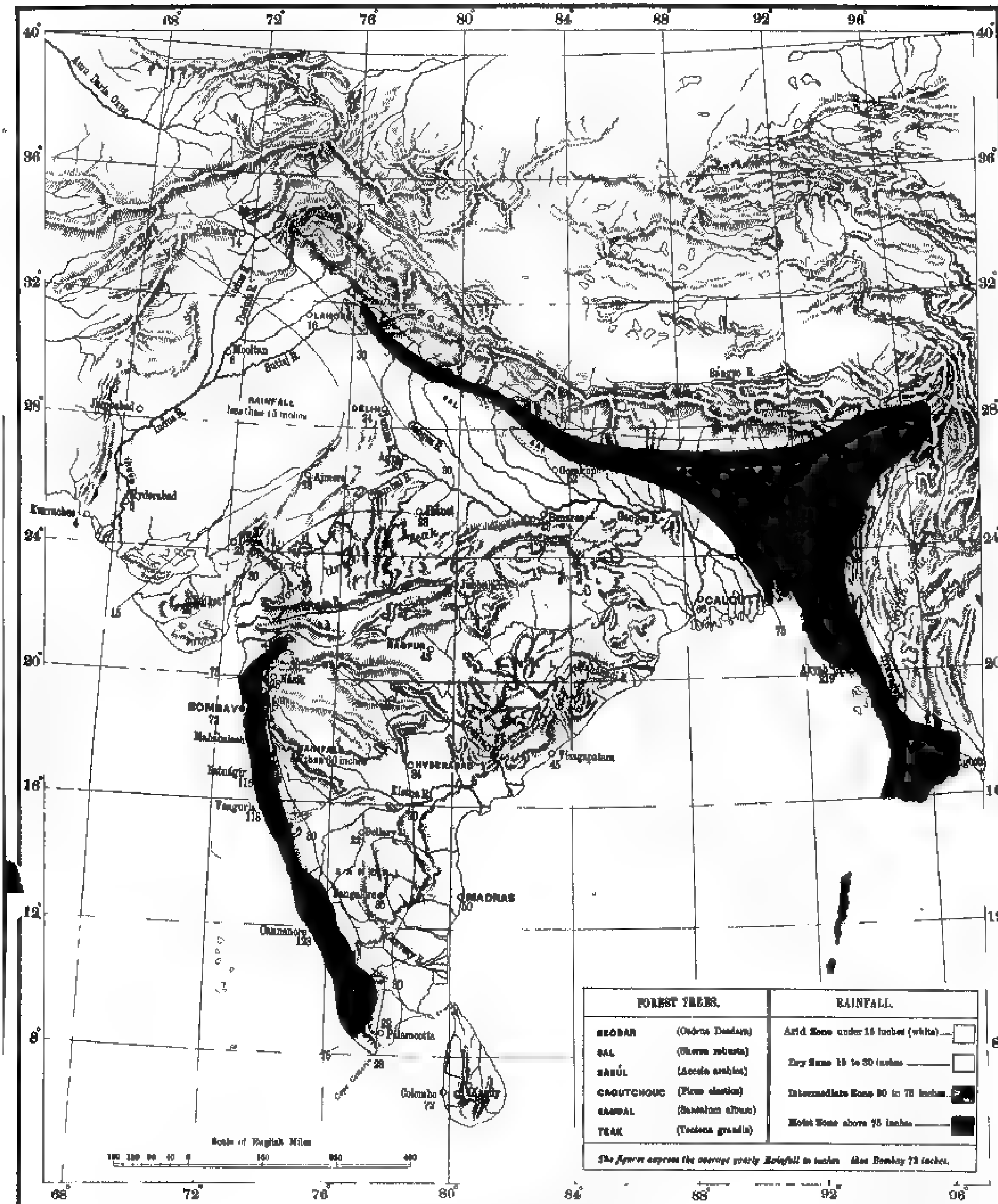
CHARLES D. PALMER.

We have very little experience in Dehra regarding myrabolams, but hope some of our Bombay friends will answer Mr. Palmer's questions.

Black myrabolams are the fruit of *Terminalia chebula*, and are collected in the Dun, in February-March.

The only preparation required for export is a careful drying. —[ED.]

RAINFALL AND FOREST TREES IN INDIA.



Photozincographed at the Office of the Trigonometrical Branch, Survey of India, Dehra Dûn, February 1883

THE

INDIAN FORESTER.

Vol. IX.] April, 1883. [No. 4.

ON THE DISTRIBUTION OF FORESTS IN INDIA.*

BY DIETRICH BRANDIS, Ph. D.

IN all countries the character of forest vegetation mainly depends on soil, climate, and the action of man. In India the greater or less degree of moisture is perhaps the most important element in this respect. Moisture and rainfall are not identical terms. Dew and the aqueous vapour, dissolved in the atmosphere, or the water derived from the overflow of rivers and from percolation, are sources of moisture as important for the maintenance of arborescent vegetation as the fall of rain and snow. It would greatly facilitate the labours of the forester, and of the botanist who inquires after the geographical distribution of forest trees, if the amount of atmospheric moisture and the formation of dew during the seasons of the year in different parts of India had been sufficiently studied; but, in the present state of our knowledge, we must be satisfied with dividing India into regions and zones according to the more or less heavy rainfall during the year. The arid region, with a normal annual rainfall of less than 15 inches, occupies a large proportion of the north-west corner of India, from the Salt Range in the north to the mouths of the Indus in the south, and from the Suleiman range in the west to the Aravulli Hills in the east. It includes the southern portion of the Punjab, the province of Sindh, the States of Bahawalpur, Kairpur, Bikanir, Jessulmir, and the greater part of Murwar. Throughout this vast region, which covers an area equal to that of the kingdom of Prussia, with a population of about twelve millions, the rains are not only scanty, but most uncertain. It is not a rare occurrence for several years to pass in succession without any showers, and then there is a heavy downpour, gener-

* The above has been re-printed from the Transactions of the Scottish Arboricultural Society, 1878, and was sent to us by Mr. Brandis, who stated that he saw no reason to make any alterations at the present time, and we have therefore reproduced it for the benefit of the readers of the "Indian Forester," few of whom may have had access to the original.

The map has been prepared through the kindness of Mr. G. B. Hennessy, Deputy Surveyor General, from the one accompanying the original pamphlet, and is an improvement on the latter in many respects.

ally in winter, and occasionally in August or September. There are, however, no regular winter or summer rains. A scanty, thorny scrub on the hills gives ample employment to the botanist, for it is here that the representatives of the Arabian and Persian flora mingle with the vegetation which is peculiar to India; but the work of the forester is mainly confined to the belts of low country along the Indus and its great branches. In Sindh, for instance, the area of forest land at the disposal of the State covers 350,000 acres, all situated on the fertile alluvial soil on both banks of the Indus, some of which is inundated annually by the summer floods of this large river, the remainder being moistened by percolation. In lower and middle Sindh a large portion of these forests consists of the babúl (*Acacia arabica*), more or less pure, with a shade so dense that very little grass or herb grows under the trees. In Northern Sindh extensive shrub forests of tamarisk, with standards of acacia and a poplar (*Populus Euphratica*), cover large tracts along the banks on both sides of the river. As the Indus changes its course from time to time, leaving dry last year's bed, and breaking through at another place, forming a new channel, the fresh banks and islands which are thus thrown up are covered at once by a dense growth of self-sown seedlings of tamarisk, with a sprinkling here and there of the acacia and poplar; while in other places large tracts of old forests are carried away by the encroachments of the river. Outside these forests, a little further inland, but still to a certain extent under the moistening influence of the river, are vast tracts of kundi or jhand, an acacia-like tree (*Prosopis spicigera*), *Salvadora*, and an arborescent, leafless caper (*Capparis aphylla*); and further north, in the Punjab, where the rainfall is more regular, and its annual amount approaches or exceeds 10 inches, dry and scanty woods, mainly composed of *Prosopis*, *Capparis*, and *Salvadora*, cover a vast extent of country on the high ground between the rivers of that province. These woodlands are commonly known under the name of rukhs, and they extend far into the second zone, which may be termed the dry region of India, and in which the normal rainfall is between 15 and 30 inches.

There are two zones of dry country,—one surrounding the arid region on the north and east, in a belt from 100 to 200 miles wide, leaving the foot of the Himalayan range about Umballa, touching the Ganges at Fattehgarh, and including Delhi, Agra, Jhansi, Ajmere, and Deesa. This I propose calling the northern dry zone; its natural forest vegetation is scanty, but better than that of the arid region. In some of the States of Rajputana there are extensive woodlands carefully preserved, to furnish cover for game, a regular supply of wood and grass, and in times of drought, pasture for the cattle of the vicinity. In the north these woods consist of *Acacia* and *Prosopis*; further south, mainly of a species of *Anogeissus*, a beautiful tree, with small

leaves, drooping branches, and dense foliage, which clothes the slopes of the old fort of Chittore and other hills in Meywar, and is the principal tree of the sacred groves of that country. On the Aravali Hills in Meywar, where cultivation mainly depends on the water stored up in tanks, the value of preserving the scanty thorny scrub on the hills, in order to regulate the filling of the tanks from rain, is recognised by some of the larger landholders. Nor must we forget that we owe the maintenance of the forests in Sindh and of the rukhs in the Punjab entirely to the action taken by the former rulers; and that during the first period after the occupation of the country, the action of the British Government has not in all cases been favourable to the preservation of the forests and woodlands in the arid and dry regions of India. Great exertions have, however, been made of late years to make up in some measure for past neglect in this respect, and in the Punjab extensive plantations have been established since 1865, which now cover upwards of 12,000 acres, the main object in the formation of these new forests being to provide fuel for the consumption of the railways, and fuel and timber for the large towns in that province. The first commencement of these plantations was made by Dr. J. L. Stewart, the author of several valuable books and papers on the vegetation of North-Western India. There is a second dry region in the Peninsula, comprising part of the Deccan, the Maidan or open country of Mysore, and several districts of the Madras Presidency. Exceptionally moist places are within its limits, such as Bangalore, which, being situated 3,000 feet above the sea, has 35 inches rain; but upon the whole, and excluding such hills as rise considerably above the table-land of South India, this belt, which stretches from Nasik in the north to Cape Comorin in the south, has a normal rainfall of less than 30 inches. This belt includes Poona, Bellary, and Kurnool in the north, and Madura and Tinnevelly in the south. Over a great part of it is found the sandal-wood (*Santalum album*), a small tree with fragrant heart wood, which comes up here and there in bushes and hedges, but does not grow gregariously, and does not form pure forests. Large quantities of this delightfully fragrant wood are used for carving and inlaid work, as incense in Hindoo temples, and there is a considerable export of it to China.

Outside these two dry zones the normal annual rainfall exceeds 30 inches, save north of the first great snowy range of the Himalaya, where rain and snow are scanty, and the country consequently arid and bare. The rest of India has a rainfall greater than that of Europe. Yet really thriving forests are only found where the fall exceeds 40 inches, and rich luxuriant vegetation is limited to those belts which have a much higher rainfall. It must be borne in mind that the annual mean temperature of Central Europe ranges between 45° and 60°,

while that of India is as high as 75° to 85°. Under a higher temperature a larger amount of moisture is required to produce rich vegetation. At the same time, in India, the supply of moisture is unequally distributed over the seasons of the year. In most districts the year divides itself into two unequal parts, —a long dry season, and a short rainy season. In most provinces of India the principal rains are summer rains, due to the prevalence during that season of the south-west monsoon, and the most humid regions are those tracts which are fully exposed to the influence of these moist south-westerly winds. In addition to these, there are Christmas or winter rains in Northern India, but they only last a few days, or at the outside a week or two, and are, moreover, extremely uncertain and irregular. On the eastern coast of the peninsula the summer rains are slight, the principal fall coming with north-easterly winds in October and November. But in the greater part of India the dry season lasts from November to May, the rains commencing between May and July, and ending between August and October. In the moister districts the rains commence early and last longer, while in the dry belts there is rain only during two or three months of the year; and in the arid region the rainfall is altogether uncertain.

The temperature during this long dry season is cooler at first and warmer afterwards. The mean temperature of the three months, December, January, and February, generally termed the cool season, ranges between 60° in the Punjab, and 79° in the south of the Peninsula. During these months dew is formed more or less, regularly, and contributes much to the maintenance of vegetation particularly in the dry and arid zones. Radiation is so powerful during this season that frost is not of uncommon occurrence in the plains and lower hills of Northern and a part of Central India. These night frosts have interfered much with the satisfactory progress of the plantations in the Punjab, and as far south as Sukkur on the Indus, in latitude 27° 30′, and the Satpúra range in the Central Provinces, in latitude 23°, frost is a serious difficulty in arboriculture. As far south as Calcutta, ice can be made on carefully prepared beds covered with straw, shortly before sunrise on a still, clear morning. The mean temperature of the three months which follow, which are generally called the hot season, is 75° in the Punjab, 85° along the coast-line, and 90° in the interior of the Peninsula, and this dry heat, with the hot scorching winds which blow over a great part of India during these months, makes this season extremely trying to forest vegetation.

With the exception of the extensive evergreen forests of the Himalaya, and the limited tracts of evergreen forests in the plains and lower hills of the humid regions, the great mass of forests in India are deciduous, and they are bare and leafless during the hot season. During this time of the year, the sojourn in the Indian

forests is not pleasant. No shade, no protection against the fierce rays of the sun, great scarcity of water in many parts, and a tent or hut with a temperature in its coolest part of 105°,—these are conditions of existence which are not easily forgotten. Deciduous, however, as applied to trees, is a relative term. The only difference is, that an evergreen tree retains its leaves longer than one which is called deciduous. Thus the spruce and silver-fir retain their needles from seven to eleven years, the Spanish *Pinus pinsapo* and the *Araucaria* retain them even longer, hence the full foliage and the dense shade of these trees. On the other hand, the needles of the Corsican and Austrian fir (*Pinus laricio*) remain three to four years; and the Scotch fir, with lighter folinge, has needles of two or three years only on its branches. The sál tree (*Shorea robusta*), one of the most important timber trees of India, with strong, hard, heavy wood, which forms extensive forests along the foot of the Himalaya and in the eastern part of Central India, retains its leaves nearly twelve months; the old leaves fall gradually, and the foliage gets thinner and thinner, until the new flush of leaves breaks out in March or early in April. So that although a sál forest is hot during that time of the year, and there is not much shade, yet the tree is never completely bare. The teak tree, on the other hand, which may be called the king of Indian timber trees, on account of its useful, durable, strong, and yet not very heavy wood, sheds its leaves as early as January, and is leafless for four or five months, though this again depends upon the supply of moisture, for in low humid places the tree often continues green throughout February. Fortunately for foresters in the hot dry provinces of India, there are to be found in most dry deciduous forests one or two kinds which break out in leaf sooner than the others, and I have spent many an hour during the heat of the day under the grateful shade of what we call the forester's friend (*Schleichera trijuga*), a tree remarkable for its extremely heavy wood, the cubic foot weighing, when perfectly dry, over 70 lbs., or nearly three times the weight of common deal.

The grass and fallen leaves, in these dry, deciduous forests, dry up rapidly during this season, and towards March and April everything is so scorched that it is as inflammable as tinder, so that the smallest spark is sufficient to create a conflagration. These jungle-fires are almost a regular annual institution in the deciduous forests of most provinces. In some instances, they are caused by accident, but in the majority of cases they arise from the temporary clearings made by cutting and burning, and the custom of the herdsmen to burn down the old grass in order to cause the fresh tender shoots to spring up as fodder for their cattle. It is true that these fires clear the ground, and make walking through the forest easier; and, up to the present time, many otherwise observant people in India have been of opinion that these fires are not mischievous, and might in some

cases be beneficial. The damage, however, done by them defies calculation. *Millions of seeds and seedlings are destroyed, trees* of all ages are injured, and often killed, the bark is scorched and burned, the wood exposed to the air, dry rot sets in, and the tree gets hollow and useless for timber. One of the most remarkable facts in the working of the Indian forests in the plains and lower hills has been the large proportion of hollow and unsound trees. In many forests one-half, in others three-fourths of the mature trees are hollow. To a certain extent this is due to the old age of the timber felled; but experience elsewhere proves that old age can only account for a small proportion of the hollow and unsound trees. The annual jungle-fires are the principal cause of this mischief. In this respect all deciduous forests in India suffer alike. With regard to reproduction, that is, the growth of *seedlings*, some trees are better off in this respect than others. Thus the sál tree ripens its seed about the commencement of the rains, after the jungle-fires have passed through the forest. The young plants thus germinate at once in great abundance. The jungle-fires of the coming season kill a good many, and cause a large proportion of the others to grow hollow; but in the dense mass of seedlings which clothes the ground under the parent trees *in a sál forest, the damage done is comparatively small.* This, to a certain extent, explains how the sál forests are nearly pure, the stronger tree in the matter of reproduction predominating over all the rest. The teak, on the other hand, ripens its seed early in the dry season, the jungle-fires consume large quantities of it; a smaller proportion of seedlings spring up, and these are either killed or cut down to the root year after year by the fires. Meanwhile, the root stock increases in size every year by the action of the shoots, which come up during the rains, and at last, often after the lapse of many years, it produces a shoot strong enough to outlive the fires. Thus what appears a seedling plant of teak is in most cases really a coppice shoot from a thick gnarled root-stock, bearing the scars of successive generations of shoots, which were burned down by the annual fires.

Protection against fires is not an easy task in our European forests. Many square miles of Scotch fir in Eastern Prussia, where this widely spread tree is the prevailing kind, have at various times been burned down, and in the cork oak and *Pinus maritima* forests of Provence the ravages have been terrible, the long summer drought of Eastern Europe and of Southern France having *in this respect the same effect as the long dry season in* India. But in India the task has been a particularly difficult one. The first step was to convince people that these fires were injurious, and when that was accomplished, to isolate the tracts to be protected by clearing broad firepaths round them, and burning down, early in the dry season, all grass and leaves in a broad belt surrounding the forests. The credit of having been the first to take in hand this important work on a large scale is due

to Colonel Pearson, in those days in charge of the forests in the Central Provinces, and now holding a most important position in the Forest Department under the Government of India. It is mainly due to his energy and perseverance that fires have been kept out for more than six years from a large forest tract of 30 square miles, called the Bori Forest, producing teak, bamboos, and various useful trees, in the Satpúra range. The effect has been marvellous, and if these exertions are steadily continued, this forest promises to become one of the most valuable in the central parts of India.

From what has been said, it will be understood that in the plains and lower hills of India the annual repose of arborescent vegetation is not caused by the cold of winter, but mainly by the drought of the hot season. Shortly before the rains set in, or with the early showers which precede the monsoon, most trees clothe themselves with fresh green, and in the arid region, where the periodical summer rains are wanting, the summer floods of the river revive the forest growth on its banks after the long drought of the dry season. In those parts of India which have a heavy monsoon, the temperature is generally somewhat lower during the summer months, June, July, and August, than during the preceding hot season. Thus it is that on the western coast of the peninsula the mean temperature of the hot season is 85°, and that of the three succeeding months, when the sky is overcast with clouds, and the force of the sun's rays is rarely felt, is only between 80° and 82°. On the Burma coast also, in Akyab, Rangoon, and Moulmein, the mean temperature of the monsoon months is somewhat lower than that of the preceding hot season. The relief from the incessant powerful action of the sun's rays, brought about by the storms of the monsoon, and the cloudy and rainy weather which follows, is delightful. It is not the vegetation only which revives; the whole animated nature feels the pleasant change. This relief is denied to the arid region. Here, in the north-west corner of India, the temperature continues to rise higher and higher with the sun, and the result is, that in June, July, and August, the highest mean temperature is found in the arid zone of India. Thus Multan has a mean temperature of 77° during what is termed the hot season in other parts of India, and of 92° during June, July, and August; and at Jacobabad, in Sindh, the mean temperature during these months is as high as 96°. Where, however, sufficient water is supplied by irrigation, these high temperatures stimulate vegetation in a remarkable manner. The station of Jacobabad is a striking example of the effect of water supply in that climate. It was founded in 1844 by General Jacob, in the midst of a barren, treeless desert. A canal was led to it from the Indus, and now the plain is a dense forest of babúl and other trees, upwards of 60 feet high, sheltering the houses and gardens of the inhabitants. A ride of a few miles takes you into the desert which skirts the hills of

Beluchistan, a level plain of splendid, fertile, alluvial soil, but hard, naked, and barren, like a threshing floor, without shrub, herb, or grass, except in the vicinity of the canals, where vegetation is rich and luxuriant.

In the *Himalayan Hills*, vegetation rests in winter as it does in Europe, and in the vast tracts of those mountain ranges the forester finds himself surrounded by forms similar to, and in a few cases identical with, the trees and shrubs of Europe. The climatic conditions are analogous, though not identical. At the higher elevations the year divides itself into the four seasons with which we are familiar in Europe, but the main supply of moisture is in summer, and the summer rains are preceded by a long dry season, which is much warmer than the spring is in Central Europe. In the outer ranges the rains are heavy, but the whole falls in torrents within a few months, and has not, therefore, the same effect upon vegetation as the uniformly distributed moisture of our own climate. There are other points of difference in the climate of the higher Himalayan ranges and of Central Europe, and this explains that some of the hardiest Himalayan trees, which grow at an elevation of 12,000 feet, within a few thousand feet of the line of perpetual snow, such as the silver fir (*Pinus Webbiana*), refuse to thrive in Great Britain and on the Continent. Even the deodar (*Cedrus Deodara*) and the blue Himalayan pine (*Pinus excelsa*), which are common in parks and gardens in England, do not thrive in many parts of Europe.

There is a great difference in the total rainfall in the outer and inner belts of the Himalayan forests. At Simla, and in the vicinity, on the outer ranges, the fall is from 70 to 80 inches, and here the deodar attains a diameter of 2 feet in from 60 to 80 years. The moist southerly currents which prevail in summer pass over the hot plains of the arid region without depositing their moisture; but as soon as they are brought into contact with the cooler air of the hills and forced upwards into regions of less atmospheric pressure, condensation begins, and their surplus moisture is deposited in the shape of torrents of rain. Thus, there is on the outer ranges of the north-west Himalaya a narrow belt, not more than 30 miles wide, with a rainfall exceeding 75 inches. Further inland the fall decreases rapidly—Kotgurh, for instance, distant 40 miles from Simla, has 38 inches only. Beyond the first snowy range the rains are scanty. Here, at the same elevation as in the vicinity of Simla, the deodar takes from 150 to 200 years to attain a diameter of 2 feet; higher up the valley, at a distance, as the crow flies, from the plains of 120 miles, spontaneous arborescent vegetation ceases entirely, the last being the tree juniper (*Juniperus excelsa*), fine specimens of which may be seen growing in Kew Gardens.

The moist zone, with a normal annual rainfall, exceeding 75 inches, which comprises the outer Himalaya, extends north-west

as far as the Dhaola-dhar range, which borders the fertile district of Kangra. Beyond this the fall even on the outer hills is less. Thus, the station of Abbottabad, between the rivers Jhelum and Indus, has only 41 inches. South-eastward the moist zone widens. In Lower Bengal the line which indicates its limit passes through Dacca, reaching the coast west of Chittagong, so that Assam, the Khasia Hills, Silhet and Cachar, Tipperah, and Eastern Bengal, are all included. This, the north-eastern moist region of India, also comprises Arracan and the coast districts of British Burma. The eastern portion of this extensive moist belt has a much heavier rainfall than the north-western portion, and here again it is heaviest on the mountains. Thus, Darjiling, in British Sikkim, at an elevation of about 7,000 feet, has 125 inches; and Cherrapunji, the former sanatarium on the Khási Hills, at 4,000 feet, has an annual fall of 600 inches, or 50 feet. On the Burma coast also the rain is heavy. Thus Akyab, the chief town of Arracan, has 219; Tavoy further south, on the Tenasserim coast, has 201 inches; and Rangoon, situated at some distance from the sea in a wide extent of nearly level country, has 85 inches.

On the higher mountain ranges of this extensive moist region forests of pines and other conifers extend from the north-west Himalaya southwards to the mountains of Burma. The deodar has its eastern limit in Kumaon, but there are other coniferous trees, which extend over the eastern part of the Himalaya range. One of the finest of these is *Pinus Kasya*, which is found as far south as the high mountains between the Salween and Sitang rivers in British Burma. These mountains are the seat of a numerous Karen population, formerly an idle, drunken, and lawless race, which, through the teaching of Christianity, brought to them by American missionaries, have become an industrious, sober, and peaceful people. Some of their villages are in the midst of these splendid pine forests, and I have often, when coming from the teak forests in the hot valleys of the Salween and Sitang, been refreshed by the delightful fragrance and cool shade of the pine trees on these hills. But, as if to remind the botanist that, though in a pleasant, cool mountain climate, he is within the tropics, and only 19° distant from the equator, there is an underwood of the sago palm (*Cycas*) under the pine trees, and most of the Karen villages are surrounded by the gigantic bamboo, which yields the posts, rafters, walls, and floors of their houses. The joints of this bamboo are so large that they are used as water pails and buckets. There is another pine tree in Burma, nearly related to a Japanese species, which grows at a lower elevation in the midst of the dry and hot tropical deciduous forests.

These tropical and sub-tropical pines, however, are not yet of much practical importance. The production of teak timber is the main object which the forester has in view in those parts of

the country. The export of teak timber from Rangoon is of old date; but, under the Burmese rule, the quantity exported never came to any very large amount. When the province of Tenasserim became British in 1826, the Attaran forests, which are situated south of the town of Moulmein, were worked with great energy, and yielded large quantities of excellent timber. The supply from that source, however, soon diminished, and thus the attention of timber traders was directed to the extensive teak-producing forests beyond the British frontier, on the Salween river and its tributaries, and from that time the importation of foreign timber into Moulmein has steadily increased until within the last few years, when the quantity floated down decreased, mainly because the stock of good timber in the vicinity of the river and its tributaries had gradually become less. Soon after the annexation of Pegu in 1853, the forests of that province were placed under a regular system of administration, and in 1858 this system was extended to the forests in the province of Martaban and Tenasserim. The result has been, that, without impairing their productiveness, the out-turn of the forests in British territory has gradually been raised from an insignificant figure to a very considerable amount; so that within the last five years they have yielded between one-third and one-half of the total quantity of teak timber brought to the principal seaports. The timber trade of the Burma ports is not large as compared with that of Canada, yet it is of considerable importance, the export amounting to about 100,000 tons annually, with a value of about £700,000. The forests in the King of Burma's territory; in Siam and the Karenee country, are much more extensive and rich in fine timber than those in our territory; yet, unless placed under a regular system of management, they will surely be exhausted before long, and on that account we must, to a great extent, look to the forests within British territory for the maintenance of the supply in future. It is satisfactory that the efforts to protect and improve the forests in British Burma have also financially been remunerative. Within the last four years the gross revenue from these forests has fluctuated between £64,700 and £98,400, and the net annual surplus to the State has been between £31,900 and £56,500.

The teak tree in Burma, as elsewhere, is found in the dry deciduous woods, never forming pure forests, but always growing in company with a large number of bamboos and other trees. Its growth is rapid while young, but slow at a more advanced age. In 1862 I sent a few teak poles, 30 feet long, to the great London Exhibition; they had attained that size in two years, in a moist part of the country, on rich soil, and protected from fire. On the other hand, the results of researches made regarding the age of mature trees have led us to the conclusion that more than 100 years are required on an average for the teak tree to attain a diameter of 2 feet. The fires clear

the ground annually of dry leaves and grass, which would otherwise form vegetable mould, enrich the soil, and keep it moist and loose. The bare ground, exposed to the full force of the sun, dries up rapidly with a hard baked surface, the rains of the monsoon rush down the hills and slopes, and the ashes, the remains of the fires, are washed away, without contributing much to the nourishment of the trees. Thus the fires do not only injure the regeneration of the forest, cause the timber to grow up hollow and unsound, but they also impair the productiveness of the soil, and retard the rate of growth of the trees. In Burma the fires are principally caused by the practice of toungya cultivation. The forest, instead of being converted into permanent fields, is cut down in January; and in March or April, when the large mass of stems, branches, and bamboos, which cover the ground, have become sufficiently dry, it is burned. On the first rainfall, rice, cotton, and vegetables are sown, and yield an abundant harvest, no ploughing and digging, only weeding and reaping being necessary. In some cases a second crop is taken; but after that, and more often after the first crop, the field is abandoned, a fresh piece of forest is selected for burning, and in this manner destruction spreads rapidly over large areas. Some of the finest teak forests in British Burma have been destroyed by these clearings; and, with the steady increase of population under British rule, the injury done by this erratic kind of husbandry has become enormous. This mode of wandering cultivation is practised throughout the wilder parts of India; in Mysore, where it is known under the name of kumri, it was possible, about 20 years ago, to protect the forests by stopping this practice throughout the country. This result was mainly due to the exertions of Dr. Cleghorn, for many years Conservator of Forests in the Madras Presidency, and afterwards employed by the Government of India in the organisation of forest administration in the provinces of Northern India. In Burma, such a summary course of procedure was not found practicable, and instead of protecting *the whole of the forests*, all that could be done was to prohibit tongya clearings in a limited extent of the best teak-producing tracts, and in those localities which were set apart for the formation of new teak forests by planting.

The selection and demarcation of these tracts, which will eventually be the State forests in that province, has not progressed rapidly, and these reserved forests in Burma do not yet amount to more than about 80,000 acres, 1,600 acres of which have been covered with teak plantations.

(To be continued).

TRANSLATION OF M. PUTON'S AMÉNAGEMENT DES FORÊTS.

B.—*Working scheme of an irregular high forest, in which the standing crop is complete.*

As far as the yield of timber is concerned, it matters little whether or no the compartments of a forest are arranged in regular succession of ages; it might even happen that a proprietor possesses several isolated woods, and works them all in accordance with one general scheme. But as regards facility of management, and protection, and disposal of produce, regularity is always very advantageous. What may not prove inconvenient in the case of a private wood, may be otherwise for a Government forest, intended to supply the wants of a certain district, or for a communal forest, which should furnish produce within easy reach of the inhabitants of the commune. The framer of the working scheme should, therefore, always endeavour to introduce this desirable regularity in the arrangement of the standing crop; and with this object he should not hesitate to fell certain compartments before maturity, and to delay fellings in others; as sacrifices thus incurred, are generally compensated for by the increased value of the latter.

The reserve to be set aside to supply unforseen wants may also balance the accidental losses resulting from those sacrifices. Working schemes offer numerous combinations, and amongst these one of the most useful in extensive forests, is afforded by the establishment of different *working series.* By this term we understand *a portion of a forest considered as an independent unit destined to be managed according to a particular working scheme, and consequently to furnish a steady annual yield.*

In a large forest area, it will nearly always be easy to arrange the compartments destined to form a complete standing crop, in such and such a working circle, and in a sufficiently regular way so as to diminish the sacrifices due to immature fellings.

The partition of large forests into working circles, has also the advantage of allowing us to distribute amongst them, the different elements of a complete standing crop, age, area, present state of growth. The differences in the conditions of growth, and consequently in the standing crops, which often form an obstacle to the formation of equal periodic blocks, can be grouped in the same working circle, and thus the yield of the whole forest be the better kept up and equalized. This will be the case, for instance, if in a forest clad valley we can arrange the bottom of the valley and the southern and northern slopes in different working circles. Equal periodic blocks established in

each of those working circles will then be as equally-productive as the nature of the case admits.

§ 2. *High forests with an excessive standing crop.*

General considerations.—It might happen, in the forest of which we are framing the working scheme, that not only are certain compartments of such an age that the fellings would reach them when too old to yield good timber, but also the volume of the standing crop may be too great for the end proposed by the proprietor, *i.e.*, for the age chosen for the exploitability. It shows as bad management to attempt to produce timber of a certain character, mine-props, or house-posts, for instance, with a super-abundant standing crop, as to manage a farm with sumptuous buildings, and artistic implements. Has a forest proprietor considered it most advantageous to fell his woods at an age of one hundred and twenty years? Has he therefore fixed upon this age for their exploitation? He will require for it a standing crop one hundred and twenty years old; and all that exceeds this limit (in any notable degree) is a luxury and an excess, the effect of which will be to diminish considerably the rate of interest, already low enough, which he obtains from his capital invested in the forest.

It will be useful to mention here, that such a case will only occur very rarely, and very exceptionally, in State forests. The interests of the State, as proprietor of forests, are the same as those of the consumer; its wants are those of national industry. Now, the larger a tree is, and the nearer it approaches maturity, the more useful are the products which it will yield. On the other hand, improved roads, railways, and canals, tend more and more to disseminate throughout a country, products which without them, had only a local market, owing to the costliness of transport. A super-abundant stock in one forest compensates for the poverty of another, and it is only where the vitality of certain blocks would be compromised by too long delay in the exploitation, that it is possible for State forests to have an excessive standing crop.

The working-scheme.—It will be understood that in high forests, where the standing timber exceeds the quantity necessary for the chosen exploitability, there are two parallel groups of fellings; one dependent on the regular working-scheme and affecting each periodic block in turn; the other having for its object to reduce the standing crop to a normal condition. There is no necessity for a provisionary rotation or period, for the regular course of the working-scheme must proceed at once, and simultaneously with the fellings intended to reduce the quantity of standing timber. These fellings, according to the nature of the standing crop, will be either removal of old trees, or fellings intended to restore irregular standing crops to a more homogeneous state. Thus, in order to avoid confusion in a

science where one is often tempted to confound the nomenclature of sylviculture with that of working-schemes, which merely distinguish in the table of fellings those of the second class under the general heading of *produce beyond the normal course of the working-scheme*, or more simply as *extraordinary produce*.

I wish to observe here, that in spite of the diversity of forest operations, in spite of all the resources which forest growth offers, it is never possible to conduct the different parts of a forest to a properly graded series of ages.

The rules of sylviculture, the exigencies of vegetation, the nature of the species, and a thousand other circumstances, are so many obstacles to the complete solution of the problem. It is better to resign oneself to a little excess in the working of a high forest than to compromise its longevity and healthy growth *by felling isolated trees, or by other operations, without a cultural object*. In a case of this kind, the excess is in reality nothing but economy and a wise foresight of future wants. In the actual state of our high forests, hitherto felled without order, without object, and with no other rule but caprice, the particular cases which come before the designer of a working-scheme, will be very numerous and very different, but the combinations of working-schemes are also very varied. I cannot point out in this simple sketch all those which practice and experience have brought before the forester: the temporary introduction of coppice for broad leaved species, or of the selection method, of which I will treat later on, are often made use of in the combinations of working-schemes.

I shall only give two examples of these combinations, but I must say before-hand that they all come under a general rule, which is as follows :—

Whatever may be the irregularity and the ages of the woods which compose the forest, we must always, when once the analysis of the compartments has been made, draw up the general table of fellings, *i.e.*, establish the periodic blocks and mark them out *on the ground*. *This marking out of the periodic blocks is* indeed the general scheme to which all the operations to be carried out in the forest must adapt themselves: it impresses the fellings with an order and character conformable to the object we hold in view; and is indeed the basis of the high forest treatment.

When once the general table of fellings has been drawn up, it will always be easy to fix the fellings which naturally result from it, as well as those which are destined, in conformity with cultural requirements, to reduce the quantity of the existing standing crop and re-arrange it in a more regular scale of ages. These fellings can nearly always be made in the first period of the working-scheme, and it would be useless to put off their completion till the second period, unless the yield should be too great for the demand. They will only be distinguished in the spe-

cial table of fellings for the first period by a single clause; their capability, *i.e.*, their annual yield, will be included in that of the ordinary fellings, so as to leave the executive entirely free to follow all cultural requirements.

First Example.—We will show how these principles apply to a particular case: a forest of 900 acres intended to be exploited with a rotation of 150 years, with a period of regeneration of 25 years, and of which the standing crop is as follows:—

A— 37½ acres, seedlings, under old beech, 15 and 120 years old.

B—712½ acres, young mature forest of silver fir with trees varying in age from 70 to 120 years.

C— 50 acres, beech poles, regular, 40 years.

D—100 acres, all ages mixed, saplings, poles and mature wood, beech and silver fir from 20 to 130 years.

900 acres.

For the working-scheme we might mark off six periodic blocks of equal area, corresponding to six periods of twenty-five years, and regenerate the first periodic block in the first period, and produce young wood by regenerating at the same time the sixth periodic block, which will be worked again in the course of the rotation, and effect thinnings in the remainder of the parcel B with the object of removing over-mature stock without breaking up the leaf canopy.

General Table of Fellings.

Numbers		Areas, in acres					
Of Periodic blocks.	Of Compartments.	Of Periodic blocks.	Of Compartments.	Age in 1880.	Period for felling.	Average age at time of felling.	Remarks.
I.	a	150	37½	15–120	1880–1904	132	
	b		112½	70–120		82–132	
II.	..	150	150	70–120	1905–1929	107–137	
III.	..	150	150	70–120	1930–1954	132	
IV.	..	150	150	70–120	1955–1979	157	
V.	a	150	50	40	1980–2004	152	
	b		100	20–130		132	
VI.	..	150	150	70–120	2005–2029	82 132 and again at 138 years.	

Special Table of Fellings.

Compartments.	Areas, in acres.	State of standing crop.	Ages in 1880.	Nature of operation.	Fellings by area.	Remarks.
		§ I. Extraordinary Fellings.				
		A. *Fellings by Volume.*				
VI.	150	Young, irregular high forest, ...	70–120	Regeneration fellings.	...	
V*b*.	100	Mixed stock of all ages,	20–130	Selection fellings.	...	
		B. *Fellings by Area.*				
...	...	...	...	...	...	
		§ II. Ordinary Fellings.				
		A. *Fellings by Volume.*				
I*a*.	37½	Seedling beech with old trees,	15–120	Final fellings.	...	
I*b*.	112½	Young, irregular high forest, ...	70–120	Regeneration fellings.	...	
		B. *Fellings by Area.*				
II.	150	Young, irregular high forest, ...	70–120	Thinnings with gradual removal of mature trees,	25 acres per annum.	
III.	150	Do.,	70–120			
IV.	150	Do.,	70–120			
V*a*.	50	Regular poles, ...	40			

The capability of the fellings by volume has been estimated as follows :—

VI. contains,	...	...	...	24,090	cubic mètres.	
V*b*. ,,	...	...	...	5,410	,,	,,
I*a*. ,,	...	...	...	3,360	,,	,,
I*b*. ,,	...	...	...	17,940	,,	,,
				50,800	,,	,,
The annual felling of $\frac{1}{25}$th will be				2,032	,,	,,

CRITICISMS ON "NOTES FOR A MANUAL OF INDIAN SYLVICULTURE."

BEFORE proceeding to make my own remarks on Captain Wood's objection regarding the words 'evergreen' and 'deciduous,' I would ask my critics kindly to overlook any, I can assure them, unintentional incivility on my part. I have been favoured with so many criticisms, that in order to complete their publication in time, I am forced to pare down my replies to the very barest skeleton, and often to adopt a curtness or abruptness of expression that is likely to wound the feelings of those, to whom I truly owe a deep debt of gratitude for the assistance which they are so generously according me.

CAPTAIN WOOD *(continued from March Number).*

I am ashamed to acknowledge I cannot quite follow Captain Wood. As far as I can make out, he objects to my definition of the word 'evergreen,' and would so alter it as to make it include also those trees, the individual leaves of which do not persist for at least twelve months, but which, owing to some new leaves coming out before all the old foliage has fallen off, are always more or less in leaf throughout the year. If no alteration is made, then he would adopt a middle term, *quasi-evergreen,* to denote this class of trees. By all means let us have 'quasi-evergreen,' but, for my part, I prefer Grigor's word 'sub-evergreen': from 'spontaneous' we derive 'sub-spontaneous.'

"For want of a better word I think 'canopied' applicable to 'a collection of trees of any age, the crowns of which meet.' With reference to an objection made to the word 'canopy,' I think that word is derived from the 'dog's feet' in metal that ornamented the bottom of the supports of a large kind of *shamiana* (to use a Hindustani word), that was carried over or placed over some great man or holy thing. The stems represent the supports, and the *connected* foliage the top of the canopy. But it appears to me the objection to 'leaf-canopy' is that it means some thing giving complete shade; and consequently, if so, the adjectives 'open' and 'interrupted' are not strictly applicable. After defining 'canopied forest' as where the 'crowns meet,' you speak of 'gaps in the leaf canopy' (page 118, line 28) and 'the leaf canopy opening out' (page 111, line 16). Now as you define 'leaf-canopy' as a 'continuous mass of foliage,' 'interrupted leaf-canopy' must consequently be a 'discontinuous continuous mass of foliage'! 'Leaf-cover' (not simply 'cover') I think gives the correct idea, and is applicable whether it be 'complete,' 'open,' or 'interrupted.' Your alternative word 'covert' is, I think, not desirable, as English woodmen and sportsmen have already adopted the word for small woods that afford cover to game.

"I notice that though you use with reference to your 'leaf-canopy' the words 'open' and 'interrupted' as used in BAGNERIS (2nd Edition of Translation, page 4), with regard to the crop, you do not use the

word 'dense'. Now if we apply 'dense' to a crop when the number of stems on a given area is very large, I think we want some definitions to express the intensity of the leaf-cover, such as—

(1), Slight,
(2), Thick,
(3), Deep.

"The effects of shade in a forest when the 'leaf-cover' is *complete* but *slight* may be very much less than where it is *open* but *deep*. I have used *slight* and *thick* in preference to *light* and *dark*. To avoid this perhaps ambiguous phrase 'light shade,' we can define the 'cover' of 'leaf-cover' to be *slight*, *thick* or *deep*, and the 'shade' in the same way can be *slight*, *thick* or *deep*."

The charge of having contradicted myself is easily disproved. To speak of *gaps* in the leaf-canopy or of *the leaf-canopy opening out* is surely no more a contradiction of terms than to say that a canopy of state is torn and full of holes, or is being worn into holes; in spite of the holes such a canopy is still a canopy. I have thus only the term 'interrupted' with reference to a leaf-canopy to deal with. We all know what a *normal forest* is, and how necessary a concept it is for the forester, whether he is discussing forestry or carrying out a forest operation. In looking at a forest in which the trees stand apart, the normal forest must always be before his mind's eye, and he may, therefore, logically say that the leaf-canopy is interrupted. Our idea of a 'man' is that he is a reasoning animal; nevertheless a fool, be he even a born idiot, is not refused the appellation of 'man,' and no one considers that the expression 'madman' involves a contradiction of terms.

I agree with Captain Wood's remarks about 'covert,' whence my reason for adopting 'leaf-canopy.'

Having shown that the employment of this latter expression leads to no contradiction in terms, I need not discuss Captain Wood's substitute, 'leaf-cover.'

With regard to his last paragraph, suffice it to say that the necessity of establishing *degrees of density* for forest crops seems to me to arise only in connection with the organisation of forests, not sylviculture or their creation and treatment. But I feel convinced that the main ideas therein involved would usefully find a place in my Chapter on the 'Struggle for Existence.'

"You give names to woody plants as far as 'formed trees,' viz., *seedlings*, *saplings*, *low poles*, *high poles*; but when the pole stage is passed, you have only one name 'formed tree.' I think we might have the different-sized trees further defined as below:—

1.	Seedlings,	...		under	6"	girth	at	[illegible]	from	the	ground.
2.	Saplings,	...	from	6" to	1'	,,	,,	1'	,,	,,	,,
3.	Low poles,	...	,,	1' ,,	2'	,,	,,	5'	,,	,,	,,
4.	High poles,	...	,,	2' ,,	3'	,,	,,	,,	,,	,,	,,
5.	Small girth trees,	...	,,	3' ,,	4½'	,,	,,	,,	,,	,,	,,
6.	Medium girth trees,		,,	4½' ,,	6'	,,	,,	,,	,,	,,	,,
7.	Large girth trees,	...	,,	6' ,,	7½'	,,	,,	,,	,,	,,	,,
8.	Veterans,	...		over	7½'	,,	,,	,,	,,	,,	,,

I think I have seen seedlings that have never been cut back defined as 'maiden seedlings.' I would use this term for seedlings that have been taken care of in nurseries and planted out, or to yearlings in the forest, that we know have not been cut over. We could then apply the term 'seedlings' to what are generally known as such in Indian forests, viz, the young plants that are in the thicket stage, which have probably been cut over several times when very young, applying the terms 'seedling-shoots' to young plants that have made rapid growth when not the result of coppice operations, and which shoots will eventually form part of a High Forest. The 'small,' 'medium' and 'large girth' trees I have so called in preference to '3rd class,' '2nd class' and '1st class' trees, as they have generally been named, as the *small girth* trees may be the largest size to which your 'small trees' generally attain, and in the same way the *medium girth* trees may generally contain the full grown trees of your 'middle sized trees,' your 'large trees' will generally grow to be *large girth* trees, and '*veterans*,' trees over $7\frac{1}{2}$ feet girth, will generally be of great age."

'Maiden seedlings' is an exceedingly happy expression; its author is, I think, Dr. Brandis, who used it first in his pamphlet on 'The Distribution of Forests in India,' published in 1873. It will of course be adopted by me.

I do not understand the distinction Captain Wood draws between his 'seedlings' and 'seedling-shoots.' They seem to me to be essentially one and the same thing.

Captain Wood's sub-division of 'formed trees' is very ingenious, but its adoption might introduce a too complicated classification.

"I think we want it properly defined where coppicing ends and pollarding commences. Many natives, to prevent stooping, cut over poles breast high, and a leading shoot springs from just below the cut surface, and, if the growth is left alone, a high forest tree is formed, either a slight bend or hollow, where the upper surface of the stump was, alone telling of the ill usage the tree suffered when it was young. But if the tree is constantly cut over above this place whenever a shoot is of a useful size, the tree gets gnarled and knotty. In the first instance was the tree 'cut over high,' and in the latter was it 'pollarded low?' We have not only to take into consideration what ought to be done, but what is done, and what should be prevented being done."

Every one will agree with Captain Wood, but the difficulty he calls attention to seems to me to be insurmountable. I think we may safely leave it to the judgment of foresters to decide in any case whether the given tree is a pollard or a true shoot from the stool.

"You say to 'cut back' is 'to fell any plant younger than a formed tree, by its base, and this with the object of obtaining, if possible, a fresh growth from it.' Is not by *cutting back* generally intended the cutting off close to the ground some plant smaller than even a high or low pole? Would not an English Forester mean some plant that could be cut with a pruning knife, or at the most a bill hook—a seed-

ling or a sapling, a plant that would eventually form a high forest tree? If not, why have also the active verb 'to coppice'? I see in 2nd Edition of Translation of 'Bagneris,' by *cutting back* 'is understood the operation of cutting down young stems close to the ground in order to make them shoot up from the stool'—*young stems*."

In an already established crop, we must often *cut back* faster-growing and overtopping individuals of inferior species or of irregular shape, in order to save or encourage the growth of those of better species or of straighter form. It is seldom that we would wish to kill outright such inferior vegetation; for a re-growth from it is nearly always useful by the protection it affords the soil, and by its favouring the drawing up of the individuals for whose benefit the operation is made. This operation could hardly be termed coppicing. Moreover, I consider it more appropriate to use the active verb 'to coppice' with reference to a *crop* and 'to cut back' with reference to the component *individuals*.

"I do not think we need borrow the French word 'exploit,' we have the English word 'exploit,' *an act, deed or work*. We want the word 'work,' thus 'work a forest,' for some thing more than the mere cutting down the trees, but we have a good English word in 'fell', thus we can say—

1. To fell.—To cut down a tree;
2. Felling.—Cutting down a tree;
3. A felling.—An area where felling is taking or has taken place; in the same way we speak of 'a clearing' in a forest where the land has been 'cleared' for cultivation;
4. Fellings.—The result of felling trees, in the same way we apply the word 'thinnings' to the result of a 'thinning' operation;
5. A clear felling.—An area where trees have been felled clear with the ground;
6. Clear felling.—The act of felling clear with the ground;
7. A part, partial, or reservation felling.—An area where trees have been felled, certain reserves being left,
8. Reservation felling.—The act of felling, reserves being left;
9. A reserve felling.—An area where the reserves have been felled;
10. Reserve felling.—The act of felling reserves;
11. Selection felling.—The act of felling selected trees;

and so on."

With reference to my reasons for adopting the word 'exploit' and its derivatives, I have explained them fully in the Number of the "Indian Forester" for December last, pages 283-286. I use also the verb 'to fell' with its derivatives. But 'to fell' is not 'to exploit.' Since writing my reply, just referred to, to Major Van Someren's objection, I am glad to say that I have seen my words 'exploitable' and 'exploitation' used, the former by Mr. A. J. Burrows in the English "Journal of Forestry" of January last, the latter by the correspondent of the "Pioneer" who writes 'Rambles in Georgia.' Both writers have employed those words

quite independently of me and of one another, and one of them is not even a forester. The words in question cannot hence be un-English.

Several serious objections may be brought against some of the terms suggested by Captain Wood; but it would take me too long to notice them. It is enough that my main point seems to me to be completely proved.

"About 'régime' and 'system.' In the 2nd Edition of the Translation of Bagneris' Sylviculture, the word 'system' is used. 'High forest system' and 'coppice system' I think do well; and I think if we can use a well established English word, we should do so. You consider (page 17, in answer to Mr. Trimen, January's Number) that 'vitality' is objectionable because it has not a convenient adjective. With 'system' you have 'systematic' and 'systematical,' and with 'régime' you have 'regimental,' and that would hardly do."

Our translation of Bagneris' *Manuel de Sylviculture* was meant chiefly for the class of English and Scotch foresters. It was, therefore, better to use the word 'system,' especially as we had no intention to *create* a terminology. The word 'system' is not wide enough for my purpose. We speak of the 'selection system,' which is only one kind of high forest exploitation. In the sense I have employed the word 'régime,' no corresponding adjective is at all necessary. For further remarks see December Number, pages 280-81.

"I think that the French word 'coupe' is unnecessary. I think that (1), 'a clear felling;' or (2), 'a reservation felling;' or (3), 'a reserved felling' sufficiently indicate an area where the felling has been (1), of every tree; (2), of all but certain reserved trees; or (3), of the reserved trees themselves. To some who have studied theoretical forestry in France, the word 'coupe' may be familiar and expressive, to many Englishmen and English-speaking natives the word I think has not a distinctive meaning. It means 'the cutting,' and I believe the words '*de bois*' have to be expressed or understood, whereas 'felling' at once expresses the 'cutting down of a standing tree.' If necessary, it could be said the 'area clear felled,' 'the area reservation felled,' 'the area reserve felled.' If we used the word 'coupe,' we should have to say the 'coupe clear felled,' &c.; so we should not gain in brevity or distinctness. I think more people would understand me if I said 'The selection felling took place in blocks 18 and 19, some 4 square miles; the fellings yielded 2,500 logs and 500 pieces,' than if having to use the words 'exploited,' 'coupe' and 'fall,' I said 'The selection coupe of some 4 square miles was exploited in blocks 18 and 19; the fall was 2,500 logs and 500 pieces."

I must first assure Captain Wood that the French word '*coupe*' means, besides 'cutting,' also the 'section cut,' and that French foresters use the word by itself without '*des bois*' thus:—*Coupe secondaire, coupe définitive, coupe jardinatoire, coupe claire, coupe sombre, asseoir une coupe*, &c., &c. Hence the charge that there is no 'gain in brevity or distinctness' at once falls to the ground. I would not say 'the coupe clear felled,' but simply 'the clear

coupe.' The test sentence used by Captain Wood is by no means a fair one, for in French itself it would run thus:—"*Le jardinage a été opéré dans les* 18ᵉ *et* 19ᵉ *Cantons* (4 *milles carrées environ*) *et a fourni* 2,500 *grosses pièces et* 500 *tronçons*," no use being made of the words '*coupe*' (in the sense of the area cut over) or '*exploiter*,' although no one would venture to affirm that those terms are redundant in the language of French foresters.

The best proof of the necessity of having separate terms for the act or operation of cutting or felling and for the area cut or felled over respectively is the ambiguity which makes it sometimes difficult to follow Captain Wood's meaning through the continually varying signification of his single word 'felling.'

"I do not think the word 'fall' is so good a word as 'fellings' for the produce of a felling. We can speak of a 'fall' of acorns or of sál seed, the seeds fall but the trees have to be felled. I am not certain if the words "fall" and "fell" (to cut down) are from the same root. I should leave the word 'fall' for trees that fall without being felled, thus we might speak of a 'fall' of timber in European forests where the ground is unnaturally overcrowded, and where after a good storm it looks as if the giants of the air had been playing the noble game of skittles or spillikins. You speak of such a fall by the name of windfall; though the front trees may have fallen from the direct action of the wind, the remainder may have been laid prostrate by the fall of the front trees. One can practically illustrate this dreaded event with a pack of cards and a puff of breath. We have to write not only for the information of Forest officers, but for those who perhaps have never seen an Indian forest, so that the simpler English we use and the fewer foreign terms we employ the better; besides, we shall have to write for the information of natives of India."

Regarding the word 'fall' I really cannot conceive what there is to argue about. It is a thoroughly English word, known to every child in Britain and America and to every first-form schoolboy in India. It is already in use in the sense adopted by me among English foresters, for proof of which read Ablett and the English Journal of Forestry. English foresters also employ it as the equivalent of my word 'coupe.'

"I think 'shade-bearing' and 'shade-avoiding' hardly give scope enough. I would propose—

1.—Light-loving.—As sissu of every age.

2.—Shade-bearing.—As many young trees at first, 'light-loving' afterwards.

3.—Shade-loving.—As deodar when young, ferns and mosses.

"In page 112 (October's 'Indian Forester,' Part IV.), when treating of the 'Density of leaf-canopy' (which I should propose calling the 'intensity of leaf-cover,' you mention, 'the young plant of any species is more shade-bearing than its older fellows, and this difference is most marked in the case of trees that are very partial to light, like the teak, &c.' I do not think the word 'shade-avoiding' sufficiently strong for plants that *are very partial to light*.

"You use a similar expression with regard to bamboos in page 119, lines 3 and 4. Again you say (page 122, lines 32 and 33) that the

majority of our Indian species 'cannot make any useful growth except under exposure to direct sunlight;' and in lines 39 and 40 you mention certain European species delighting in almost perpetual sunshine:' after this I think we want the word 'light-loving.'

"I find that Major Van Someren noted the same lines that I did, viz., lines 26-30, page 118, where you write 'shade-bearing trees will at once spread out a branch here and a branch there into any interstices they find.' You evidently mean 'shade-bearing' trees cannot *bear* shade when they can get light. I think you start with a false premiss when you state that *shade* is the opposite of *light*. *Darkness* is, I believe, generally considered the opposite of *light*, *shade* being generally held to be what you describe it (in page 287, line 38), viz., *diffused light*. Shade requires the presence of light (without light there can be no shadow), *darkness* means the absence of light."

Before doing anything else, I must admit my inconsistency in my reply to Major Van Someren ("Indian Forester" of December last). I ought to have maintained throughout, as I have done at the end of that reply, that 'shade' is *diffused* as opposed to *direct* sunlight, which last we may often safely term simply 'light' without risk of ambiguity. But that verbal inconsistency does not vitiate my argument, which is that no tree or shrub *loves* the absence of direct sunlight; it can *bear* it, and those woody species that grow in deep shade, grow there, not because they avoid the *light* of the sun, but because they are too delicate to stand its *heat*. In other words, what Captain Wood and those who agree with him call *shade-loving* plants, I would term *shelter-loving* plants.

The preceding remarks, and those made in pages 286-87 of Vol. VIII. and page 61 of Vol. IX. of the "Indian Forester" are, I think, a complete answer to any objections that can be brought against my division of trees and shrubs into two broad classes, the one in a general manner *shade-bearing*, the other *shade-avoiding*.

"You have defined *dormant buds*, why not define *adventitious buds?*"

Thank you for reminder. This omission will be supplied.

"Your remarks on Mr. Hearle's. In Oudh and the North-Western Provinces, the native name for *Shorea robusta* is *sákhú*; *sál* is the name generally applied by Europeans. The natives apply the word to the heartwood of various trees, thus they speak of the *sál* of ebony, amaltas (*Cassia fistula*) and jigna (*Odina Wodier*)."

I have at last found a doughty champion in at least one matter. Will Mr. Hearle kindly read these remarks of Captain Wood's?

MAJOR VAN SOMEREN *(A rejoinder)*.

"Use your own discretion in printing the following, for you may well have little room to spare for mere fighting over words. But should you print it, then I would urge that your definition of *evergreen* is too limited. Surely it is question of colour not of time, and

that time arbitrarily limiting the word 'ever' to 12 short months. Why cannot a tree that stands out plainly and palpably green to the eye, and in full leaf, all the year round, be just as much evergreen as a tree that is not greener in colour or fuller in leaf, but which keeps the majority of its individual leaves on throughout 12 months? You say on page 288 of December's 'Indian Forester' that as far as you have been able to judge, the leaves of certain Eugenias do not persist for a whole twelve-month, 'hence, they are not evergreen trees.' Excuse my asking if this is not a rather big *sequitur*, and, if it should prove true, is it not somewhat early to accept it on one man's observation just now?"

Major Van Someren is not quite just to me. No one can be more open to conviction than myself, and it is with the very object of having my mistakes pointed out that I solicit criticism.

"With regard to your full answer to my criticisms, see 'Indian Forester' for December last, I wish to make no further reply than to point out that if your contention for 'exploit' and 'exploitation' is good, then you should ask Government, on grounds given by you at page 284, to style you officially 'Superintendent of Exploiting Plans,' for your plans will deal with much more than 'felling a forest in accordance with the principles of sylviculture.'"

My meaning has evidently been misunderstood. It is just because a *working* plan provides for more than the mere *exploitation* of a forest or its 'felling in accordance with the principles of sylviculture,' that the designation of my present office is correct.

"Then you say on page 286 of the same Number, that 'shade is the opposite of light,' and that 'to love shade is the same thing as to avoid light.' So, according to your own showing, 'to love diffused light is to avoid light!' Even now-a-days, we find '*quandoque dormitat Homerus*,' though Homer sings here among the Indian Siwaliks instead of 'on the Chian Strand'! However, on no battle-field is one more likely to leave openings for attack than on one of words. You say many support you. I yield to numbers, but am neither convinced nor beaten."

I quite agree with the Major. *Aliquando si dormitat et bonus Homerus, minora canentibus nonne licet vel dormire?*

E. E. FERNANDEZ.

NOTES ON BOX, ALPINE BIRCH, AND *QUERCUS SEMECARPIFOLIA* FORESTS OF THE WESTERN HIMALAYAS.

As Mr. Fernandez, in the December Supplement of the "Indian Forester," asks for information concerning the Himalayan Box forests, the following may be of interest to him and others.

In Jaunsar the box forests are situated at the head of the Amlawa and Amtiar streams, which rise close together, about 2 miles below Deoban, and at an elevation of 6,000 feet or there-

abouts. The rock is limestone, and the finest trees were found at Jadi, amongst large, loose, limestone rocks, in warm, moist, shady ravines. It is probable that the nature of the soil, the comparatively low elevation, and the moisture, all contribute to rapidity of growth. The box here is generally pure, but some Ban Oak (*Quercus incana*) may be found occasionally intermixed at the lower limit, and the Moru Oak (*Quercus dilatata*) and the Spruce towards the upper limit.

On the Jumna these forests, I believe, formerly formed a continuous belt for 20 miles from Kotnur to Kharsali, the last village before the snows are reached, but only small isolated patches now remain, the rest having been cleared for cultivation.

The elevation varies from 4,000 to 8,000 feet, but most of the box is found in a narrow belt near the lower edge of the forest between 6,000 and 7,000 feet.

The rock is either gneiss or mica-schist, and the thick layer of vegetable mould proves the rarity of fires.

Although its gregarious tendency is very apparent, it is constantly found associated with Oaks (*Quercus dilatata*), Maples (*Acer pictum*, *A. villosum* and others), Elms (*Ulmus Wallichiana*), Horse chestnuts, Hornbeams (*Carpinus viminea*), Himalayan Hazels (*Corylus colurna*), and towards its upper limit with the Spruce and the Silver Fir. The shrubs forming the undergrowth are the Ringal (*Thamnocalamus spathiflorus*), Euonymus species, Brambles (*Rubus flavus*, *R. rosæfolius* and *R. biflorus*), Roses (*Rosa macrophylla* and *R. moschata*), *Philadelphus coronarius*, *Cornus sanguinea* and *C. oblonga*, *Lonicera* species and *Leycesteria formosa*. There is little or no grass, and Aconites, Pæonies and Balsams occur with other herbaceous plants.

Box is partial to a northerly aspect and shady ravines, but is also found on the side of hills. It grows under dense shade and quite in the open, but in the latter case often in the midst of fields, on rocky grounds, and on soil too poor for cultivation, when it is dwarfed and knotty.

Cultivation is the great danger for these forests, which almost all border on fields, and are thus sure to suffer by its extension. Grazing need not be feared, as neither sheep nor goats eat the leaves, and fire seldom enters the forest. As a rule there are a sufficient number of seedlings on the ground.

The villagers use the leaves for manure, the wood for comb-making, and for fuel when no other trees are close at hand, but the damage done is not great, except when the trees are killed for the sake of temporary cultivation.

The growth of box on the Jumna is, I think, slower than in Jaunsar, and probably from 30 to 35 rings per inch of radius, whereas in the latter locality there are perhaps only from 20 to 25 rings to the inch. On the Jumna, I believe the trees begin to deteriorate before they attain a girth of 2 feet, whereas in Jaunsar they may be sound up to 2½ or 3 feet in girth.

Four pieces of box were weighed with the following result.—

				Weight per c. ft.
1.	A piece from Persia,	..	..	67·7
2.	" from the Jumna,	..	..	66·9
3.	" " "	..	..	65·1
4.	" from Jaunsar,	..	..	55·8

4,324 box trees were counted over 1 foot 6 inches in girth, and 8,553 between 6 inches and 1 foot 5 inches.

The largest tree had a girth of 5 feet 6 inches, but the trunk was very knotty, and the wood probably useless.

I have visited two Alpine Birch forests during 1882, one on Tadola Hill, above the village of Kopra, on the Upper Jumna, and the second above Jamnotri.

I am sorry to say I had no means of determining the height of *Tadola Hill*. In the Birch forest at the time of my visit, 7th June, the trees were only just beginning to put forth their leaves and young catkins. *Betula Bhojpattra* was the only tree close to the summit, with an undergrowth of *Rhododendron campanulatum* then in flower, *Caltha palustris, Corydalis meifolia, Potentilla microphylla, Saxifraga Stracheyi* were amongst the herbs. Lower down the birch occurred mixed with *Quercus semecarpifolia, Spiræa sorbifolia* and *Pyrus foliolosa*. The forest above Jamnotri was a similar one, and, judging from appearances, fires never occur.

To the allies of the *Quercus semecarpifolia* given in the notes, I would add the Spruce, the Silver Fir, the Holly (*Ilex dipyrena*), *Piptanthus nepalensis*, and *Thamnocalamus spathiflorus*. Anemones form an important part of the herbaceous ground covering.

N. Hearle.

CATTLE GRAZING IN DEODAR FORESTS.

In the discussion which is being carried on in the "Forester" on this subject, reference has been made to the Jaunsar Bawar forests under my charge.

My experience amongst deodar forests is of the briefest, but my observations, so far as they go, have led me to the conclusion, that the system now in force, one of the objects of which is to obtain a natural reproduction of deodar, requires modification.

I fully agree with Mr. Moir that the state of the Koti forest is far from satisfactory. In 1881 deodar seeded abundantly all over Jaunsar, but at Koti, Bodyar and other closed forests very few seedlings of that year can now be found.

In Bodyar, especially, a large number of seedlings were observed in May last, by the sides of paths and in other places free from grass, but amongst the grass itself, which is very luxuriant, scarcely one could be discovered after the most diligent search.

As an experiment, I hope to be able to open Koti forest to graz-

ing for the bullocks and buffaloes of three neighboring villages during the months of July, August and September next. This limited grazing will, I trust, by keeping down the grass and undershrubs, both lessen the danger from fire while at the same time it will prepare the ground for the deodar seed when they arrive, but after these have germinated and the young plants have established themselves in sufficient number, cattle should be carefully excluded.

N. HEARLE.

NOTES ON CULTIVATION OF RAINY SEASON VEGETABLES.

In this, as in a former paper on the cultivation of hot season vegetables, I have only described the varieties generally preferred by Europeans. Most of the vegetables peculiar to the rainy season are rank growers, and require more room than the average sized garden can spare. Those not included are not of much value, and, unless variety is an object, they may be safely left to the care of the native grower. If ever required, he will supply them as cheap as one can grow them.

Khíra, (Cucumber,) *Cucumis sativus.*—The rainy season varieties of this vegetable are very distinct from the variety with small egg-shaped fruit cultivated during the hot season. Two varieties are common in India, although as far as flavour is concerned, there is little to choose between them. When in a young state the colour of one is a dark green, and of the other creamy-white. When full grown both are about a foot long, and the colour changes to a rusty brown. These two, although not equal to the commonest varieties met with in England, are not to be despised. They thrive with little care, and are always sure of yielding a crop. I annually try some of the English varieties, but have never been able to ripen a single fruit. They sometimes form, but invariably rot before attaining maturity.

In order to have them in use all through the season, three sowings should be made, the first in April, the second in May, and the third in June. Rich soil should be selected, and the seeds sown in lines 5 feet apart. When the young plants are about 4 inches high, supports should be given for them to climb on. The first sowings should be regularly watered, until the rains begin. Afterwards none need be given unless a break of more than ten days' duration should occur.

Kali Turai, (*Luffa acutangula*,) *Ghia Turai*, (*Luffa ægyptica*).—These two vegetables require the same mode of cultivation, and may therefore be described together. When full grown, the fruit of the first named is about a foot long, and of an angular shape. When cut for use, it should never exceed 4 inches in length. If cut when longer, it is quite useless for the table. The fruit of the second is about 6 inches long, dark green, and slightly spotted with creamy-white. It must also be cut when quite young.

Two sowings of both will keep up a supply from July until October. The first sowing should be made in April, and the second in the end of May, or beginning of June. The seeds should be sown in lines at the same distance apart as cucumbers. The general treatment required is the same as described for the latter, and need not be again detailed.

Chachinda, (Snake Gourd,) *Trichosanthus anguina.*—The fruit

of this vegetable is from one to 3 feet long, and of a very handsome appearance. When young they are beautifully striped with white and green, and when ripe change to a brilliant orange. The young fruit is used as a substitute for French beans. When cut up into thin strips and boiled, they form a fair imitation of that vegetable. Like the Kali and Ghia Turai, the fruit must be used when very young. If cut when more than 4 inches long they often have a very bitter taste.

Two sowings should be made, the first in April, and the second in May. The distance apart and general treatment is also the same as described for cucumbers, and need not be again detailed.

Karaili, (*Momordica Charantia.*)—This, although botanically the same species, is a different variety from the one grown during the hot season. The natives of this district call the hot season variety Karaila, and the rainy season one Karaili. The former variety does not require any supports to climb on, but the latter does. The fruit of both is much alike, however the rainy season variety is, on the whole, smaller.

One sowing is enough to make of this vegetable. If this is done in the beginning of June, it will keep up a supply all through the rains. It also requires the same treatment as the cucumber.

Al Kadu, (Lauki,) *Lagenaria vulgaris.*—The fruit of this vegetable, if cut when quite young, is nearly equal to the vegetable marrow in flavour. Its size and shape varies very much. Some varieties are nearly a yard long, and others are compressed into short club-shaped gourds, not above a foot long The flavour of all are nearly alike, and it is of little importance which variety one may possess.

It can be sown as early as February, and as late as July. However for rainy season use, two sowings should be made, the first in April and the second in June. The first sowing will be ready for use in the beginning of the rains. The second will come in about the middle, and keep up the supply until the cold season. It can be sown in nurseries and transplanted, or sown at once where intended to be grown. The latter mode is preferable, but if an empty plot is not available when the sowing season arrives, it is better to adopt the first named, than let the sowing season slip past. It succeeds best in heavily manured sandy soil, but will thrive ordinarily well in any. When sown or transplanted, the seeds or plants should be inserted in patches 6 feet apart. No supports are required, as it prefers to trail along the ground. It should be weeded when necessary, until the patches interlace and cover the ground. Afterwards it will not require to be touched, as the dense network of branches will keep down the weeds.

Kadu, (Pumpkin,) *Cucurbita maxima.*—There are several va-

rieties common in gardens. The commonest one is a large globular gourd, and of a brown colour when ripe. If cut when about a pound in weight, their flavour resembles that of the vegetable marrow. It is also very good if used when full grown.

The seeds should be sown from April to June. It is a gross feeder, and requires very rich ground. The distance apart and general treatment is the same as described for Al Kudu, and it is needless to detail it over again.

Bhuta, Makai, (Indian Corn,) *Zea Mays.*—The cultivation of this plant requires little care. There are numerous varieties in cultivation. It is a popular plant in America, and of late years that country has raised a large number of improved kinds. Although much superior to the varieties cultivated in this country, they cannot be depended on to produce a crop on the plains. For ordinary garden cultivation, and where a supply of corn heads is the first consideration, it is better to grow the indigenous varieties, and leave the American kinds to the care of the experimentalist.

In order to have a supply of the green unripe heads of corn all through the season, it should be sown at intervals of a fortnight. The first sowing should be made about the middle of May, and the successional sowings continued up to the middle of July. The seeds should be sown in lines, 15 inches apart, and 12 inches between each seed. When the plants are a foot high, they should be earthed up like potatoes. If the soil is rich and heavy, they will succeed very well without this being done, but if poor and light, the operation is very beneficial. It brings a greater supply of food within easy reach of the roots, and also lessens their chance of being blown over during storms.

Bhindi, (Hibiscus esculentus).—This is a very wholesome, although not a palatable vegetable to every one. The fruits when cooked, are very slimy, and for this reason many do not care for it. Those who do not consider this an objection find it palatable, and as it is easily managed, a few plants are not out of place in a garden.

It should be sown from April to June. One sowing is sufficient for keeping up a supply all through the rains. It should be sown in nurseries, and when 3 inches high, transplanted in lines 2 feet apart, and 18 inches between each plant. It will also succeed fairly well if sown at once in the plot where intended to be grown, but succeeds better if transplanted. It should be regularly weeded all through its period of growth. The oftener done the better, as frequent weedings keep the surface soil loose and open.

Lobia, (Vigna Catiang).—This is an annual plant with narrow pods from 6 to 12 inches long. It is one of the most useful of the bean tribe for rainy season cultivation. There are many varieties of Saim *(Dolichus)* cultivated during the rains, but as

hardly any of them are ready for use until the cold season, I have excluded them from this paper.

This species should be sown just before the rains, and will be ready for use about the middle, and continue until the beginning, of the cold season. The pods should be gathered when about 6 inches long. If gathered when longer they are tough and stringy. It should be sown in lines 4 feet apart, and treated in the same way as cucumbers.

W. G.

DEODAR AND THE HIMALAYAN SILVER FIR IN ENGLAND.

Most Himalayan foresters will read with interest the following extract from a letter, communicated to us by Mr. A. Smythies, from Messrs. James Backhouse & Son, the great nurserymen of York:—

"In reply to your enquiry, we believe that, in point of fact, there never was such a thing as what is usually called 'acclimatisation' anywhere. What *has* been done has been merely *finding out* what the constitution of each species, or variety, *will bear* in the way of climate.

"*Abies Webbiana* will not endure the casual (and especially, *late*) frosts of low situations: but at an elevation of 500 or 600 feet, on well-drained hillsides, it grows very freely, and forms a magnificent tree. Severe mid-winter frosts rarely injure it, perhaps we may even venture to say 'never.'

"The Deodar, so far as we have seen, always suffers severely (and often fatally) with a frost of great intensity, say thermometer at or below zero. In low ground, it is therefore almost useless. At 500 feet it has a very good chance in many situations. 1,000 feet is too high.

"Personally we should plant freely, and measurably fearlessly, both these conifers in the situations which we have just specialised. We think you will find, as a rule, that where natural hardiness is the result of *high latitude*, there is nothing to fear, but that when supposed hardiness results from *high altitude* of *native locality*, the risk in all our low-lying ground is very considerable."

Our readers will of course understand that the last sentence refers only to the British Isles.

THE

INDIAN FORESTER.

Vol. IX.] May, 1883. [No. 5.

ON THE DISTRIBUTION OF FORESTS IN INDIA.

BY DIETRICH BRANDIS, Ph. D.

BESIDES the dry, deciduous teak-producing tracts there are in the moister parts of the lower hills of Burma extensive and most luxuriant evergreen forests, composed of a large variety of trees, often 200 feet high and more, and so dense that except on the numerous paths trodden by wild elephants, or on the scanty foot-paths which lead from village to village, it is almost impossible to penetrate through them. The forester classifies trees with special reference to the amount of light which they require. The Scotch fir, for instance, demands a great deal of light ; its seedlings will not readily spring up and thrive under the shade of its own kind or of other trees. The beech, spruce, and silver fir, on the other hand, can stand a great deal of shade ; their seedlings will maintain themselves a long time in the deep shade of the forest, growing very slowly, making very little progress ; but when a clearing is made accidentally or intentionally, they will shoot up with great vigour. Where woodlands are managed on a large scale, the peculiarities of each kind of tree are carefully studied, and the treatment of the different classes of forest adapted to them. In India, teak demands a great deal of light. On the other hand, most of the trees which compose the tropical evergreen forest will stand a great amount of shade ; and thus it happens that the underwood of these dense forests does not only consist of shrubs and climbers, but to a great extent of seedlings of the very trees which form the dense shady roof overhead. When one of these old giants falls, the mass of seedlings takes a start, and as they all strive upward to the light they draw each other up to a great height, the weaker plants perishing in the fierce struggle for existence. The trees in these forests cannot, however, either in height or growth, be compared to the Wellingtonia of California or to the Eucalyptus of Australia. The tallest tree which I have seen and measured in India was 250 feet high and 38 feet in girth. This was a species of upas tree (*Antiaris*), in the Thoungyeen forests of British Burma. Such dimensions, however, are never found in the deciduous forests. The tallest teak tree measured by me was 102 feet to the first branch, with perhaps, an addi-

tional 50 feet of crown above. Teak trees with clear stems, 60 to 80 feet to the first branch, are not rare in the moist regions of India. I have found them in Burma, in the Dang forests, north of Bombay, and in those glorious but hot forests of North Canara, which are probably the most extensive and richest teak forests remaining in British India. Teak of such size and length is only found in very favourable localities where the young trees had grown up close together on rich dry soil, in dells or sheltered valleys, generally in company with tall bamboos, and where they were thus compelled to draw each other up to that height.

Luxuriant vegetation, under the influence of an abundant supply of moisture, has its drawbacks, however, as well as its advantages. Thick masses of tall grass and weeds spring up in the teak plantations of Burma, smother the young trees, and greatly increase the risk of fire. Worst of all are the climbing plants with which the teak, sál, and other forests in all moist tracts abound. Huge creepers, like gigantic ropes, often as thick as a man's thigh, and thicker, stretch from the ground to the top of the trees: they give off numberless branches, and their foliage completely covers and smothers the crown of the tree of which they have taken possession. When a young tree is attacked by one of these gigantic climbers, the stem remains short, gets crooked and deformed, and makes no progress in growth. In Burma several kinds of epiphytic Ficus attack teak and other trees; the seed germinates in a fork or in a hollow of of the trunk, sends down its roots, which eventually enclose the stem as with a network. At last the tree dies, and the Ficus spreads its massive but useless limbs in all directions. In the sál forests of Oudh the climbers were particularly heavy and numerous when these tracts came into our hands. Owing to several favourable circumstances, it was possible in that province at once to set apart and demarcate a large area of forest land as State forests, and the work of cutting the climbers was at once taken in hand and completed at a considerable outlay; so that now these forests are almost entirely cleared of large climbers, and the young sál has a chance of growing up straight, and forming valuable timber.

Much smaller in area than the north-eastern moist region is that which extends along the western coast of the Peninsula. It begins north of Bombay, and, guided rather by the character of the vegetation than by meteorological observations, which in those wild tracts we do not possess, I have included in it the northern Dangs, a dense and most feverish forest district at the foot of the Khandeish ghâts. The eastern limit of this western moist zone runs nearly parallel with the crest of the ghâts, but at a short distance from the ghât line. The moist zone thus includes the edge of the ghâts, their western slope, and the hilly country between the ghâts and the coast-line. Its width varies from 50 to 100 miles. Surat, with 47 inches of rain, is outside;

Bombay, which is included, has a fall of 72 inches only, but Tanna, a few miles inland, has 102. Further down the coast, the rainfall is heavier. Ratnagiri has 115 inches, Vingoria 118, and Cannanore 123. But the heaviest fall in this zone is on the crest of the ghâts. Here, as on the outer ranges of the Himalaya, and the Khasia Hills, the moist currents of air coming from the west, which strike against the steep face of the ghâts, are forced upwards, into a cooler and more rarefied air, and the consequence is an extremely heavy downpour during the monsoon. Thus the Sanatarium of Mahableshwar, south of Bombay, 4,300 feet above the sea, has a fall of 250 inches; but Panchgunny, at a distance of only 10 miles inland from the crest of the ghâts has 50 inches; and Poona, 30 miles from the ghât line, has a fall of only 27 inches. This rapid decrease of moisture inland explains that the western limit of the southern dry belt runs within a short distance from the crest of the ghâts. At the southern extremity of the Peninsula the rain near the coast diminishes, so that Cape Comorin, with 28 inches, and Palamcotta, with 22, fall into the southern dry zone.

Forest vegetation in the western moist region is in places fully as luxuriant as in Burma and Eastern Bengal. There are the same great classes of dry deciduous forest, with the jungle-fires as a regular, annually recurring institution, and the moist evergreen forests, including what are commonly called the Sholas of the Nilgiris, into which the jungle-fires do not enter. The rich variety of trees in both descriptions of forest has been carefully studied by Major Beddome, the present* head of the Forest Department in the Madras Presidency, and author of the first forest flora published in India, containing a full account of the trees and shrubs of Southern India. In the forcing climate of Malabar, in the heart of this moist region, is the oldest and as yet most extensive teak plantation in India. Commenced in 1844 by Mr. Conolly, then Collector of that district, its present extent is upwards of 2,500 acres. A hundred acres on an average were planted annually, so that there is a regular succession of thriving plantations, the oldest being now twenty-eight years old, with tall stems 70 to 80 feet high, a splendid instance of the rapid growth of the teak tree in its youth, under good care and in a favourable climate. The northern half of the western moist zone is in the Presidency of Bombay. In this part of India a regular administration of the public forest-lands was attempted as early as 1846, and the result of the early attention paid to this matter may be seen in a large and steady forest revenue between £82,000 and £123,000 annually during the last six years, one-half of which has been a net addition to the general revenues of the Empire. At the same time, the forests in several districts of the Presidency have considerably increased in

* 1873.

value; they now contain a larger stock of growing timber than at the time that conservancy was commenced, and plantations have not been neglected.

While thus a good deal has been done to increase the growth of useful *indigenous trees*, the introduction of foreign trees has not been neglected in India. The splendid table-land of the Nilgiris, which is raised 7,000 feet above the hot plains, is in places getting rapidly covered with forests of exotic trees. From Australia several kinds of *Eucalyptus* and *Acacia* were introduced about twenty-five years ago, and they have made such progress that the station of Ootacamund is now almost surrounded by a forest of these trees. Their rate of growth is wonderfully fast, much faster than that of the indigenous trees. At the same time, young forests of the quinine-yielding *Cinchonas* are coming up in many *places*. The management of these Cinchona woods will probably be similar to the treatment of oak coppice in England; for though oak bark has not one-twentieth the value of Jesuit's bark, it is the bark in both cases for which these woods are mainly cultivated. There will, however, be that difference that while oak coppice in Europe, after having been cut over, requires from fourteen to twenty years to yield another crop of bark, Cinchonas appear to grow so rapidly that they may probably be cut over every eighth or tenth year. Fever is the great scourge and calamity of India, for natives as well as for Europeans. Cinchona bark, and *more so* pure quinine, are the only effective remedies, and, if they were less expensive, millions in India would be benefited by them. The natural forests of the more valuable kinds in South America are approaching exhaustion. Experience has sufficiently proved that some of the most valuable species succeed well on the Nilgiris, in Ceylon, and on the lower hills of British Sikkim, and that they yield an abundance of quinine. But the localities where the best kinds can be grown in India are limited, and it would be well if as much of the available area as possible were planted with Cinchonas. It has been said that India owes more to the Portuguese than to any other nation in the matter of plants and trees introduced from abroad, and certainly the papaya, guava, custard-apple, cactus, pine-apple and agave, all naturalised more or less directly through their agency, bear testimony, in almost all parts of India, to the skill and activity of the early Portuguese settlers. On the other hand, it is due entirely to British enterprise and energy that the Coffee tree, which was introduced about a hundred years ago by a Mussulman saint from Arabia into South India, and first cultivated on the Bababooden Hills, in Mysore, is now grown in numerous extensive well-managed *plantations*; that Tea, the existence of which in India was hardly known forty years ago, has become an important, annually-increasing article of export; and, lastly, that the Cinchona tree was successfully introduced from South America, and promises to be one of the greatest blessings to the people of India.

So much will be clear from these remarks, that in the climate of India the luxuriance of arborescent vegetation is a sure index of moisture. A glance at the map might tempt us to go farther, and to say that the limits of distribution of the different species in India seem to depend in a greater degree on moisture than on other climatic conditions. The northern limit of teak, it is true, seems to be more influenced by the temperature of the cold season than by moisture. Natural teak forests are not found where the mean temperature of the three cool months is considerably less than 60°, though the tree will stand occasional night frosts, which are not uncommon in some of the valleys of the Satpura range. But no teak is found on the Aravulli Hills about Ajmere, though that place has a mean temperature of 65° during the cold season. In this direction it apparently is the want of sufficient moisture which has limited the further extension of the species by natural means. By cultivation, this, as most other trees, has been extended far beyond its natural limits; numerous fairly-growing teak trees are found in gardens in Bengal, the north-west, and even in the Punjab; a teak plantation has been commenced at Sikkim; and it has been proposed to cultivate this valuable tree on a large scale in Assam. Within certain limits the teak tree does adapt itself to different conditions of soil and climate; but limits there are, and, as far as our present knowledge goes, it thrives best with a rainfall above 30 inches, a mean temperature during the three cool months of between 60° and 80°, and during the rest of the year between 70° and 90°. Teak is spread over a great part of the dry belt of Southern India, but only as poor coppice, yielding a scanty crop of poles and rafters, and never attaining any large size.

The sál tree is found in two large belts, one extending along the foot of the Himalaya range from Assam to the Sutlej river, with a few outlying patches beyond, and the other occupying the eastern part of Central India. The sál depends, to a much greater extent than the teak, on certain peculiarities of soil; it is mainly found on sandstone, conglomerate, and gravel, but does not thrive on the heavy clay-soil which overlies the extensive trap-rocks of the Deccan and part of Central India, and this peculiarity may have a considerable influence in limiting the area of its distribution. It stands more cold than teak, but it does not seem to thrive with less than 40 inches of rain.

A far more limited range of distribution has the Caoutchouc tree (*Ficus elastica*), a tree which is frequently grown in conservatories and drawing-rooms in this country and on the Continent; so much so, that in Germany it goes by the name of the Berlin weed. Its milky juice yields a description of India rubber, not equal to the excellent Para rubber, the product of an altogether different kind of tree in Brazil, but which may be capable of improvement by a more careful method of collection. In India this Caoutchouc tree has only been found in the moist

forest skirting the Eastern Himalaya from Sikkim to Assam, and at the foot of the Khasia and Cachar Hills. A humid atmosphere, and equable temperature throughout the year, seem to be the principal conditions of its free growth. The mean temperature in the stations nearest to the Caoutchouc forests is between 60° and 65° in the cold seasons, and 80° and 85° in the three hottest months.

The conditions of existence under which the deodar grows at the north-western end of the Himalayan range are altogether different. To begin with, it demands a certain elevation; as a rule it does not thrive in the north-west Himalaya under 4,000 feet, but it ascends to 10,000 and at times to 12,000 feet. As to mean temperature, a range between 35° and 50° in the cold season, and 65° to 75° during the three summer months, seems to suit it best. As regards humidity, the Indian cedar does not go beyond certain limits of drought and moisture. In the Sutlej and other Himalayan valleys it disappears where the arid region commences, although the conditions of soil, temperature, and elevation are not unfavourable. Again, it is wanting in the Eastern Himalaya, where the rainfall exceeds 100 inches. The deodar is so closely allied to the Cedars of Lebanon, the Taurus, and the Atlas mountains, that botanists find it difficult to keep them distinct as species. A close comparison of the climatic conditions under which these western cedars grow, with the climate of the north-west Himalaya, may lead to interesting results regarding the history of the spread of these beautiful and useful trees. It is not, however, climate, soil, and the action of man in historic times alone, which determine the area over which plants or trees are actually found at the present time; other far more remote causes have been at work, the study of which forms the most interesting part of botanical geography. The forester, however, has to take things as they are, and to him the most important point is to ascertain the conditions most favourable for a vigorous growth of those trees which pay best, and which yield the largest quantity of timber and other forest produce within a certain time on a given area.

The other trees indicated on the map, babúl and sandal-wood, are satisfied with a moderate supply of moisture. The babúl tree is spread over a great part of India, but it is wanting or does not grow well in the moist zones. Without irrigation it seems to grow best under a rainfall between 15 and 60 inches; and where moisture is supplied from below, it thrives well in the driest parts of India. The sandal-wood is at home in India mainly in the southern dry zone; it demands a hot dry climate. In gardens it is grown in many of the more humid districts, but the heart-wood is less fragrant and less valuable. The tree is not, however, limited to India; it is also found in the Indian Archipelago, and there are other species of the same genus yield-

ing sandal-wood in the Fiji and other islands of the Pacific from whence it is largely exported to China.

What has here been advanced makes it sufficiently clear that there exists an intimate connection between the climate of India and its forest vegetation. The practical aspect of the subject, however, has not yet been touched upon. Well may the question be asked, why we should trouble ourselves concerning the maintenance and improvement of the forests in a country which has a civilisation many centuries older than our own, which has existed and has maintained an immense population so long, without feeling the want of any systematic care of its forest lands? I must ask the reader at once to dismiss the idea that by preserving and improving the forests of India we may hope materially to change and improve its climate. It is a widely spread notion, entertained by many writers who are competent to judge, that forests increase the rainfall, and that the denudation of a country in a warm climate diminishes its moisture. Much of what is known regarding the history and the present state of the countries round the Mediterranean seems to support this theory, but it has not yet been established by conclusive evidence. In India, where, directly or indirectly, the success or failure of the crops depends on rain at the right time and in suitable quantity, it is natural that the conservancy and improvement of its forests should have been regarded as one of the means to be employed for a better regulation of the rainfall. Many remarkable facts are recorded, which seem to show that in comparatively recent times, the denudation of certain tracts has been accompanied by changes in husbandry, indicating a diminished or less regular rainfall. There is not yet, however, sufficient evidence to prove that a material deterioration of the climate has been the result of denudation in any part of India. Much less has it been established that by preserving and extending the forests we may hope considerably to increase the rainfall. Not that a country covered with forests is not under certain circumstances likely to have more frequent and heavier showers than a hot barren desert, but there is no prospect of our carrying out in India any measures on a sufficiently large scale to effect any appreciable improvement of the climate. In the moist zones, and in a large portion of the intermediate region, the country would not benefit if the total annual rainfall was increased. The land would undoubtedly produce more frequent and heavier crops if we could by any means more equally distribute the moisture over all seasons of the year. The seasons in India, however, are regulated by the dry north-easterly winds which prevail during one-half of the year, and the wet south-westerly currents which reign during the other half; and these, again, are the results of the rotation of our globe, the position of the sun, and the distribution of land and water on our hemisphere, and of other cosmic phenomena which will not be affect-

ed by any forest cultivation in India. What might be extremely useful would be to increase the rainfall in the arid and dry regions, where the cultivation of the land to a great extent depends on irrigation, and where a dry season causes famine of the most terrible character. If by any means we could increase the atmospheric moisture in the drier districts of the Deccan, in parts of Mysore, Rajputana, Sindh, and the Southern Punjab, these countries might maintain a dense population in prosperity. But of such improvements all prospect is denied to us. If it were possible to cover any large proportion of these dry districts with forests, the stratum of air overlying the top of these forests would undoubtedly be cooler and moister, and during the south-west monsoon this would certainly bring down a few additional showers. But it is not possible. Save along the banks of rivers, there is no moisture to raise and to maintain such forests, which I fear will remain a fond hope not to be realised in our time. By preserving and improving the woods along the coast of the western ghâts, it has been stated that the rainfall in the dry country beyond might be increased. As far as our knowledge reaches at present, it seems probable that heavy forests along the edge of the ghâts, and in their vicinity, have the effect of increasing the local fall of rain along this belt; but if this is the case, the westerly winds will be drained of their moisture, even to a greater extent than if there were fewer forests, and there might possibly be less condensation and less rainfall in the dry country beyond.

Nevertheless, there is no doubt that every grove and every group of trees in the dry and arid regions of India is a blessing, the value of which cannot be estimated too highly; and though we may not be able to raise extensive forests in these districts without irrigation, yet a great deal can be done by improving and extending the wooded tracts along the borders of the dry country. Save in the most arid districts, mere protection from cattle, cutting, and fires is sufficient to produce, not, it is true, dense forests but brushwood and grass, which certainly, in a small way, serve to keep the ground cooler and moister. There is no country in India where the beneficial effects of mere preservation of brushwood tracts in a dry climate may be better studied than in some of the Native States of Rajputana. Such Chiefs as the Rajah of Kishengarh, the Thakúrs of Bednore and of Hamírgarh, and their ancestors, have set a good example, which the forest officers of the British Government will do well to imitate.

Whatever views may be held regarding such slow, gradual, and limited effects of forest growth upon the climate, there is no doubt that, in a hilly country, forests enable us in many cases better to husband the existing water supply for irrigation. Whether the drainage from the hills is collected in tanks and artificial lakes, as is the case in Rajputana and Mysore, or

whether it is employed to feed canals, to carry water, fertility, and wealth into distant districts, the object is the same—to utilise to the utmost the water supply available during the year. Experience in India and elsewhere has proved that where hills are bare, the rain rushes down in torrents, carrying away loose soil, sand, and stones, silting up rivers and canals, breaching or overflowing dams and embankments; but that where the hills are covered with meadows, fields, or forest, the superficial drainage is gradual, the dry weather discharge of rivers regular, the springs better supplied; in short, all conditions united to insure the more regular and useful filling of tanks and canals; and in many cases the attainment of these objects is in itself of sufficient importance to justify measures for the preservation and improvement of natural woodlands, and for guarding against the denudation of hilly tracts. *The preservation of forests* may be made necessary by other objects of a cognate nature; for instance, in order to protect roads and bridges in hilly tracts, to guard against landslips, to prevent the formation of ravines, the silting-up of rivers, and other mischief which may follow the denudation of hilly tracts.

Nor is it at all impossible, that in some cases the preservation and extension of arborescent vegetation may have a beneficial effect upon the sanitary condition of a district. The late unhealthiness of Mauritius has generally been ascribed to the gradual denudation of the island; and public feeling there has been so strong upon the subject that legislative measures have been proposed to facilitate the re-foresting of the waste lands. Too much importance must not, however, be attached to the value of forests in India from a sanitary point of view. The district of Ratnagiri, which is situated south of Bombay, between the coast and the ghâts, has been densely inhabited for centuries; and in consequence mainly of the practice prevailing in the Concan, of manuring the fields with ashes of leaves and branches, the whole district has gradually been denuded of trees, save groups of pollards, which are annually lopped for manure, groves of palms, and fruit trees in gardens. Yet this district is proverbially healthy; more so than the adjoining British districts, Tanna and Colaba in the north, and Canara in the south; nor is there any proof that the rainfall of the Ratnagiri district is less than it ought to be with regard to its position on the coast. Nevertheless, even here denudation has done serious mischief. Several of the short tidal streams of this part of the Concan, which were navigable in former times, have gradually silted up, and are now useless, except for very small craft.

Beyond all doubt, however, forest conservancy in India has become necessary in order to meet the growing demands for timber, wood and other forest produce. Under the influence of peace and security, which all parts of the country are enjoying under British rule, prosperity is increasing rapidly in most

provinces. The peasantry of entire districts, who have hitherto been content to live in miserable huts, desire to build good substantial houses and to use better furniture. Hence an increased demand for bamboos, wood, and timber. In certain forest tracts the watershed of the timber trade has entirely changed since the American war has stimulated the export and cultivation of cotton. From the forests of North Canara, the former export of timber was all seawards, and fortunately it was not of great importance, and has not exhausted the forests. The export inland was trifling. Since the American war, however, a considerable demand of timber and bamboos for the cotton producing tracts east of Dharwar has sprung up, and a brisk trade is now carried on in that direction. Similar changes in the lines of export have taken place in the Kandeish Dangs, and elsewhere in many places. The rapid construction, within the last twenty years, of railways, canals, and public buildings of all descriptions, has created large demands for timber and wood. Although a considerable proportion of the railway sleepers laid on the Indian lines were brought from Europe, the demand in India for this item alone has been so heavy, that within the last fifteen years extensive forest tracts have been denuded of nearly all their standing marketable timber, to furnish railway sleepers. In every respect, therefore, the drain upon the resources of our Indian forests is heavier now than it was formerly, and is likely to remain so; and unless the small extent of remaining valuable forest is carefully managed, with a view to its regeneration, there will certainly be difficulties hereafter. For the law that an increased demand will always produce an increased supply does not hold good when the supply requires one hundred years to become available.

It is not, however, timber only the permanent supply of which we must endeavour to secure for the benefit of coming generations. There seems no prospect of finding coal in sufficient quantity in North-Western India. Railways and steamers in the Punjab and Sindh burn wood, and will probably continue to do so. At the same time, the demand for fuel in the towns and villages of Northern India will increase. Hence the necessity of extensive plantations, and of careful management both of the scanty woods on dry ground, and of the more productive forests along the banks of the rivers. These are the future requirements of India in this respect, and they must always hold the first place in the consideration of public measures of this nature. For, after all, if it were not for the benefit of the people of India, there would be no reasonable ground, for undertaking the arduous task of preserving and improving its forests. On the other hand, the interests of trade may justly claim to be heard in this matter. Sandal-wood, cutch (the produce of *Acacia catechu*), caoutchouc, lac, teak timber, and numerous other kinds of forest produce, are important articles of export

from India, and the maintenance of a sufficient supply to satisfy the requirements of trade is a matter of great moment. Nor does the export of these articles benefit the merchant only; it adds largely to the prosperity of the people of India.

These are the principal reasons why forest conservancy in India is necessary. A more difficult question is, how the objects we have in view are to be attained. Forests, like all other landed property, can be either in the hands of the State, of towns, village-communities, or other public bodies or corporations; or, lastly, in the hands of private individuals. There are thus two ways of accomplishing our object. Either the State must, by legislation, subject all forest property to a certain control for the public benefit, reserving to itself the right of compelling the proprietor to manage it in accordance with certain rules and prescriptions laid down from time to time, as circumstances may require. In many European countries this plan has been more or less successfully pursued, and in most is still maintained with regard to forest land which is the property of municipalities, villages, and public corporations. In France, for instance, the management of all these classes of forests is under the control of the State Forest Department; and, upon the whole, the system works well. Similar arrangements exist in Prussia and in other German countries. Private forest property, however, is practically free in most European countries. Nearly all European States hold large forest domains in the hands of Government, and this makes it possible to maintain an efficient body of public forest officers, with practical experience, competent to manage or to control the forests of other proprietors.

Italy has, it is true, of late years pursued a different policy, but its success is doubtful. The greater portion of the State forests and of the ecclesiastical estates, which might have been formed into State forests, have been sold; and the project of a law, placing such tracts of private and other woodlands, as may from time to time appear necessary, under the control of the State forest officers, has repeatedly been discussed, but as yet without any practical result.

In India, everything tends to show that the State must endeavour to retain as many of the more important forest tracts as possible in its own hands. In the first instance, this seems the only way of forming an efficient body of forest officers with practical experience. In the second instance, the control of forests in the hands of other proprietors will, in India, always be a peculiarly difficult matter. Not that the formation of village forests, and their regular management under the control of State forest officers, would not be a most desirable object to aim at. Certainly, the advantages of well-managed communal forests are great. The public property thus created cannot readily be converted into cash, and wasted by an improvident generation. It yields a fixed and certain annual revenue, avail-

able for roads and other public improvements. In many parts of continental Europe, long experience has shown that well-managed communal forests increase the prosperity of communities and their inhabitants, facilitating at the same time the development of healthy municipal institutions. And though at present it would be premature to expect the people of India to appreciate the advantages of such institutions, the time will certainly come when the importance of proposals tending in this direction will be recognised. But so much seems certain, that the State ought not to undertake the control of forests of other proprietors until its own forest officers have the needful practical experience, and are competent to manage them to the best advantage.

The general principle, that the more valuable forest should as far as practicable be formed into State forest domains, has, after much opposition, gradually been acknowledged in most provinces of India; and in some provinces the process of demarcating these State forests has made considerable progress. From a late return, I gather that the area of the reserved forests in the provinces under the government of India, outside those of the Madras and Bombay Presidencies, but including the forests leased from native princes, is estimated at 9,800 square miles, or 6,200,000 acres. In India, these forests are called "reserved forests," as they are formally reserved from sale, except by the express permission of the Supreme Government. By way of comparison, I may mention that the Crown forests of England cover 112,000 acres, the State forests of France upwards of 2,500,000, and the State forests of the kingdom of Prussia upwards of 6,000,000.

The area here given for India, however, includes a large extent of forests which are not the property of the State, but which are only leased for a definite time from Native Chiefs and Princes. It also includes a large extent of woodlands, which have not yet been finally demarcated, or in which, though the State may be the proprietor, the surrounding agricultural population exercise rights of pasture, of cutting wood and timber, and, in some cases, of clearing ground for cultivation. In a few provinces, such as Sindh and the Central Provinces, circumstances were favourable at the time of demarcation, and the State acquired at once absolute proprietorship of these forest lands free of all prescriptive rights. In other provinces, the gradual adjustment and extinction of these rights, which materially interfere with the protection and systematic management of the forests, will be a work of time, which will require much care, patience, and conciliatory treatment of the people concerned. In this, as in other matters relating to the administration of forests in India, we are guided by the experience gained in this country, and on the Continent of Europe, in dealing with rights of commons and other prescriptive rights in forest land. There has been much thoughtless

talk is if the natives of India, in burning the forests and destroying them by their erratic clearings, were committing some grave offence. If the matter is carefully analysed they will be found to have the same sort of prescription which justifies the commoner in the New Forest to exercise his right of pasture, mast, and turbary. Such rights, when the public benefit requires it, must be extinguished; but the wild tribes of India have the same claim as the holder of prescriptive forest rights in Europe to demand that provision be made for their reasonable wants and requirements. The State forest domains in India are thus in course of formation only; the greater mass of them is in a poor and exhausted state; many are burdened with heavy rights of pasture and other prescriptive demands. For many years to come they must be worked most sparingly; considerable sums must be expended on the demarcation and survey of boundaries, on roads, the clearing of streams, on plantations, and other improvements. At the same time, all these operations and the protection of these extensive tracts require large and expensive establishments. These are the reasons why the administration of the public forests in India has not yet within the short period of its existence yielded any large surplus revenue to the State. The gross income of the Government forests in British territory has within the last three years fluctuated between £420,000 and £465,000; but the charges have been high, and the highest net surplus of the year has amounted to £160,000 only, and in another year fell as low as £86,000.

Nevertheless, there is no doubt that financially also, the formation of State forests in India, and their methodical management, will eventually be an important source of revenue and strength to the Government. In this, as in all matters, the first commencement has been difficult. The idea of providing for coming generations may to many appear an unnecessary waste of time; but when the present generation begins to derive substantial benefits from these measures, then their value will doubtless be fully recognised.

TRANSLATION OF M. PUTON'S AMÉNAGEMENT DES FORÊTS.

Extraordinary produce.—It is evident, that in such a forest, there is an extraordinary volume of standing timber which will no longer exist during the second period, and which it is always useful for us to estimate. For in the case of a State forest, this produce will have to be shown under the heading of *extraordinary revenue;* and in a communal forest, it is useful that the commune should know what proportion of its forest produce might be employed for any special public works; and finally, if the forest is private property, its extraordinary produce could be used to buy up rights of usufruct, &c., or in other words, to improve the value of the property. To estimate this extraordinary volume, we must not attempt to separate the produce of the ordinary from that of the extraordinary fellings, or to calculate a special capability for each kind of produce, thus—

Ordinary produce.	Cubic métres.	*Extraordinary produce.*	Cubic métres.
Ia, ...	3,860	V*b*, ...	5,410
Ib, ...	17 940	VI, ...	24,090
Total, ..	21,800	Total, ..	29,500
Capability $\frac{1}{25}$th = ..	852	Capability $\frac{1}{25}$th =	1,180

The effects of this procedure would be to allot a certain area for the extraordinary volume, and would inconvenience the foresters in selling the produce without giving accurate results. We must not indeed confuse *abnormal* with *extraordinary* produce. The latter can only occur in forests with an excessive standing crop; it cannot possibly exist, where the standing crop is insufficient, although in a working-scheme for such forest, one is often obliged to glean certain produce outside the limits of the current periodic block in order to spare the proprietor as much as possible. In forests with a superabundant standing crop, it may even happen, that the first periodic block has already been largely exploited, that it contains little produce (the forest under consideration is an example of this), and if we consider produce gathered beyond the ordinary fellings as *extraordinary*, we are liable to form a completely false idea of the meaning of the word. Each of these terms has its own proper meaning.

The expressions "*normal and abnormal produce*" involve the ideas of the areas from which the produce is to be gathered during the first period, which has nearly always a preparatory or transitory character.

The words "*ordinary and extraordinary produce*" are applied, the first to the ordinary out-turn of the forest for the age of the chosen capability; and the second, to everything in excess of this out-turn taken during a certain interval from pre-existing capital. The amount of this portion of the produce depends on the age fixed for the capability, but not on the combination of compartments in the working-scheme. The only way to estimate this extraordinary volume is to compare the total amount of the produce to be felled, with the quantity, which the forest might furnish, if its material were regular for the age chosen for its exploitation: We will estimate the yield of an acre on which the forest growth is of average quality, and a hundred and fifty years old. It is a question of practical experience, the solution of which will be nearly always aided by sample plots chosen either in the forest itself, or in adjoining ones. If the figure is 240 cubic métres an acre, in the present case, we should multiply it by the area of the current periodic block, and compare the result with the total volume to be felled; the excess will represent the extraordinary volume as nearly as we could wish.

		Cubic métres.
Total volume to be felled, ...		50,800
i. e., normal produce, ...	21,300	50,800
abnormal ,, ...	29,500	
Ordinary produce valued at 240 cubic métres per acre 240 × 150 = ...		36,000
The extraordinary volume is ..		14,800
The ordinary capability is fixed at		1,440
The extraordinary volume offers a mean annual yield of		1,080

It will often happen that this extraordinary volume will be placed in reserve by the proprietor and utilized for the unforeseen demands on his income which may occur during the 25 years of the first period. But if a private person requires these 14,800 cubic métres, and wishes, nevertheless, to place in reserve a portion of the annual yield; if a commune sets them apart for a work of public utility, and yet wishes to have a fourth of its forests in reserve, and only to distribute three-quarters of the normal forest yield, amongst the inhabitants, it will be necessary to distinguish between *ordinary fellings*, *fellings in the reserve*, and *extraordinary fellings*. We shall make the following note in the remark column of the table of fellings:—

If it be a communal forest with one-fourth in reserve:—

			Cubic métres.
Total volume to be felled, ...			50,800
thus distributed,	1. Ordinary fellings (1,080 per annum), ..	27,000	50,800
	2. Fellings in the reserve, ..	9,000	
	3. Extraordinary fellings, ..	14,800	

If it be a State forest—

Total volume to be felled, ... 50,800

thus distributed,	1. Ordinary fellings (1,440 cubic métres per annum),	36,000	50,800
	2. Fellings in the reserve (the annual increment of growth),		
	3. Extraordinary fellings, ..	14,800	

Record of the working-scheme.—In this case the record of the working-scheme will be kept in the manner we have pointed out, its form can be adapted to all cases. It will suffice to add an extra column for the fellings made in the extraordinary volume, and it will be clearer, if we write ordinary fellings in black ink, fellings in the reserve in red ink, and extraordinary fellings in blue ink.

This record has special importance in communal forests; how are we to reject the incessant demands of a commune, if we cannot show, by carefully kept records, in what position its reserve and other resources may be at any time? Is not the working-scheme the contract for the management of the forest settled between the proprietor and the public department entrusted with its execution? A contract, the fulfilment of which can be demanded from the Civil Courts, and should we, in cases of dispute, expose ourselves to appear before the Court without proper evidence?

2nd Example.—A rather complicated case is that of the forest of H............ which, with an area of 1,250 acres, is stocked with pure silver fir, very regular, and of a uniform age of 180 years.

If for instance in such a case the whole standing crop were to be felled in a transitory rotation of 20 or 30 years, we should at the end of this time have the forest stocked with timber from one to 30 years old, and the public would be deprived of large timber for a long period, at the end of which the same situation would recur. We should also during the transitory rotation be liable to the disadvantages of a forced sale of valuable produce, felled in excess of the local demand.

The following plan might be followed—we might divide the forest into six periodic blocks, corresponding to periods of 30 years each, the first being regenerated in the first period, preparatory fellings being made in the second, and selection fellings by area and with a five year's rotation, being introduced into the third, fourth, fifth and sixth periodic blocks. This scheme, which is far from being perfect, since it introduces a method of culture which has been objected to by many authors, has at any rate the advantage of retaining the cover complete throughout the forest, of distributing a large proportion of the volume of the standing crop during the whole rotation, and of fulfilling the principal object of every working-scheme, which is to prepare a complete and regular standing crop for the second rotation.

NOTE ON A RECENT CASE REGARDING DRIFT TIMBER.*

A CASE of some interest has recently been under appeal to the Chief Court of the Punjab, connected with the law relating to drift timber. The facts (which are not stated clearly in any one of the judgments) are as follows :—(It may be premised that a Native Magistrate first convicted—his judgment is not material: the Sessions Judge at Lahore, reversed the conviction, and an appeal was further made on behalf of the Crown against the acquittal to the Chief Court, who upheld the Sessions Judge's order). The Chenab river is one of those on which deodar timber is floated both in log and in sawn scantling. It often happens that either scantling escape control, or that rafts are broken by accident, and the component parts of them get scattered and sent adrift. As the river subsides these pieces,—logs, beams and especially sleepers,—get stranded on the banks, where of course they

* Chief Court, Punjab, Criminal Appeal, No. 250 of 1882, *Empress v. Riddi Kishn and others* (8th August, 1882).

are especially liable to be cut up, removed, or concealed in the sand and grass, and ultimately stolen. A Forest officer visiting a village which has a river frontage on which such drift sleepers are frequently deposited, found a large shed or out-house, belonging to the accused person, the roof of which was made of deodar rafters, which he showed consisted of river-borne *and water-worn* sleepers. In some cases the sleepers had just been cut in two, so that on removing them and placing them side by side on the ground, the two pieces fitted and together formed one sleeper cut down the middle. *No actual mark or device indicating ownership was found on any of the pieces.* The accused was arrested and was not charged under Indian Penal Code, Section 403, (misappropriation,) but under one of the rules made under Section 51 of the Act, which runs to the following effect :—(3). "No person "shall without such permission (*i. e.*, permission to collect and "dispose of drift timber) cut up, remove, conceal, burn, mark, "or efface or alter any mark or marks on, or sell or otherwise dispose of such timber." 'Such timber' means timber described in the rules (viz., in No. 1) as timber which has, by accident, to the rafts, or from not originally having been caught and formed into a raft, *gone adrift without control.*

It is obvious that *drift* has been beyond specially defined in the Act, the term "drift timber" has its ordinary meaning (which is not at all obscure or doubtful) by that of timber which has floated away and got stuck or stranded *out* of the control of any person in charge of it.

The decision of the Magistrate was not clear, and there is no occasion to allude to that. The defence was practically made and re-argued in appeal before the Sessions Judge. The prisoner did not deny the possession of the pieces, nor the ownership of the premises, *nor did he plead in so many words,*—"this is not drift timber within the meaning of the rule—therefore I have broken no rule, in cutting it up or removing it." He merely pleaded that he *could account for* the timber and prove that he bought it. So far all is clear. In the appeal to the Sessions Court the learned advocate who conducted the appeal, tendered accounts, &c., to show that the accused (appellant) had duly bought *logs*, and had *sawn them* up, into pieces with which he had roofed his house.

The Sessions Judge expressed himself unable to see how the defence touched the charge. No technical skill was necessary to distinguish brown, stained, round edged, abraded, water-born sleepers, (that had been sawn in the forest, and had suffered long steeping, rubbing, wearing and exposure in the river course of some 400 miles to the plains,) from rough-grained, sharp-edged pieces sawn in the plains out of water-borne *logs.* The charge was that the accused had water-worn sleepers, the defence showed that he had power to account for locally sawn pieces ; it was as of being charged with possession of spoons, he

accounted for his possession of forks. The Sessions Judge then decided that though this defence was of no effect, still the man was entitled to be acquitted, because it was not shown by the prosecution that those water-worn sleepers found in the roof, were actually *drift timber* within the meaning of the rule.

There was much *suspicion* no doubt, and in any case, the difficulty of proof would be great, but a prosecutor cannot get off the duty that it is *for him to prove* his case, merely because proof is naturally difficult.

It was no doubt true that many really drift sleepers did often land on the sandy shore. It was well-known that villagers, generally, did remove them, it was also *very possible* that the sleepers were in fact such sleepers stranded, and surreptitiously removed. Moreover, it would *not have paid, to roof such a building* with deodar pieces, if those pieces had been paid for at the ordinary price of such timber.

More than that the prosecution could not make out. And on the other hand it was equally possible that the sleepers were not *drift*, but had been bought at cheap rates from Kashmir dealers.

The Government officers urged (1), That the prisoner had not denied that the timber was drift, but had tried to account for his possession and failed; (2), The above facts constituted sufficient proof of the timber being drift.

The Judge held, that when a defence lay clear on the face of the proceedings, even if the prisoner through ignorance (and Counsel would be little help to him in such a matter) did not put his defence quite clearly; still he was entitled in common justice to get off, if looking at the whole case, the prosecution had not established what under ordinary rules of law they were bound to prove. In appeal to the Chief Court it was said that the Judge had made for the prisoner a defence which he had not made for himself. The Chief Court found it unnecessary specifically to decide whether a Judge was justified in making a defence for a prisoner which he had not made for himself. It is submitted, therefore, that the question in this form is not capable of abstract settlement. There may be cases where the Judge would not be justified, and there may be cases where he would: in the present instance, the necessity of the prosecution proving affirmatively that the timber *was drift*, was a legal one patent on the proceedings, without it, even if the prisioner had merely pleaded not guilty, and set up no theory in defence at all, he would had been entitled to an acquittal.

You cannot go into a man's house and say, 'here is an article; I cannot positively say it is mine, nor can I positively say that I have been robbed of a number of similar articles of which this is certainly one; but it is *very like other articles of which from time to time I am often robbed*, therefore I take you to the police station, and put you to prove that this article is *not mine.*'

That is the principle here. The Forest officer could only say

generally, that sleepers just like these, *were often stranded* on the shore, and such would certainly be *drift* within the meaning of the rules; and that such sleepers in general, were often surreptitiously cut up and removed: further than that the case could not be proved.

Now, if there was *no possibility* of getting sleepers except *drift* sleepers, then this fact would have made the above facts into a very strong case: but on the Chenab there are very great possibilities of getting such sleepers otherwise. Dozens of Kashmir dealers and Agents bring down their sleepers: and as these merchants are frequently in debt to the Maharaja of Jamu, that potentate often seizes their timber and sells it *all over the place, wherever it may be*, for a mere song. So that it was *highly possible*, that these sleepers were not drift, but had been bought from the Kashmir dealers, perhaps under not very creditable circumstances: but still they would not in that case, be *drift*, nor could their removal be an offence against the law in question.

It was not right then at all, to put the prisoner on his defence: there was no legal presumption to start with that *the timber was drift;* this should have been proved to start with, and it was not so proved.

The acquitted has been upheld in the Chief Court, though there is an important confusion in the Court's judgment about "river-borne" timber which was very natural, until Forest law is thoroughly understood by the Government Pleaders who conduct cases before the Court, so that they can explain such things. *All* deodar is of course "river-borne" (we may leave out the local exception of deodar beams brought by the cart-road to Umballa), but the difference between a river-borne *sleeper*, as above described, and a sleeper *cut* (in the plains) *out of a river-borne log*, is so obvious to the eye, that the absurdity of the defence trying to prove the *latter*, in defence of a charge of having the *former*, is what gave rise to all the doubt in the case.

The accused nowhere stated that they had bought *water-borne sleepers*,* with their peculiar color and appearance, but that they had bought *logs* and cut them up *in situ*, which is quite another thing.

Otherwise the Court completely upholds the ruling, that the prosecution must first prove that the timber was "drift," and that it was removed after the rules came into force.

Section 45 of the Act raises the presumption that all *drift* timber is *Government property*, but it raises no presumption that any particular timber is *drift*.

* Thus Mr. Justice Barkley says,—"The timber, though *river-borne*, a fact which the accused themselves appear never to have denied as they admitted that the greater part of it had been cut out of *shatirs* (sleepers), which they alleged they had purchased." This is not quite correct, they only said they had cut them out of *river-borne logs* (*all* logs being river-borne,) which is quite a different thing from cutting up *water-worn sleepers*.

"There is no evidence, said Mr. Justice Elsmie, to show that the particular timber from which these rafters had been made, was timber that had passed the last catching place, without being brought under control, or that it had broken loose, * * * * and become stranded. It appears just as probable *primâ facie* that this river-borne timber was stolen from rafts, or otherwise, or was purchased by the accused.

It will be no doubt a difficult task in future for Forest officers to protect drift timbers which is lying on the banks, &c., of rivers declared under the Act. They will virtually have to prove that in certain places drift timber was seen lying, by the guards, and that the timber so noted has been removed. If that is done, then, there can be little doubt that a person found in the vicinity with timber clearly identifiable as timber just like that deposited by the river, and since removed by human agency, would be justly taken up, and called to account for how he got the timber: it would then be no defence to show that the accused bought river-borne logs (all logs being such) and sawed them up, since a sleeper, sawn up from a log, could never be mistaken for a sleeper, discolored and abraded by a long water passage.

In the course of the judgment, the Chief Court incidentally remarked that Section 45 making "drift timber" *primâ facie* Government property, extended only to the purposes of Chapter IX. of the Act; and it was suggested that a charge under the Indian Penal Code, Section 403, for criminal misappropriation of unmarked timber (*i. e.*, of timber not actually Government's or the prosecutor's own) would not lie.

It is respectfully submitted that this view is incorrect: we shall not however discuss the point here; it was not *ruled*, and is a mere remark in the course of the judgment, as the point was not directly in issue; it is therefore open to have the matter considered and argued on any future occasion when it does directly come up. It would be then, we think, easy to show that Section 45 was enacted, not at all for the purpose of making a few rupees for Government in case the timber was not ultimately claimed, but with intent to give Government *the right to protect, and take action in favor of* all timber lying or floating adrift and out of control, and which private persons have no power (in the nature of things) to protect for themselves. Indeed, if private persons did, without restriction, try to protect it, the risk of theft would be greater than ever. Now one of the first powers necessary to protect timber so placed under Government control, is to be able to punish persons who steal or misappropriate it. If any one could be proved to have directly misappropriated drift timber which was stranded and noted as such in a given spot: he could most certainly be convicted under Section 403, Indian Penal Code.

THE NECESSITIES FOR JUMING.

It is now many years since Government seeing the waste of

forest caused by juming, endeavoured to put a stop to the practice by pointing out to its officers, the desirability of putting some sort of pressure on those who pursued this "wasteful and vagrant custom" as it was called.

Near Darjiling, Sir Ashley Eden had hopes of producing some effect, by summoning the chiefs of those communities that jumed, and having its desire explained to them.

In vain the chiefs urged the impossibility of confining their people to one plot of ground, but seeing Government determined they promised to do all they could.

Some two years after, it was officially recognized that the custom was not in the slightest degree abated. The people jumed as before, regardless of the orders. On looking into the matter it is noteworthy that the custom is extremely old, and evidently preceded the Aryan irruption into India by which *the plough was introduced, and that juming despite a few exceptions* is in India a race character of the great non-aryan group. It appears pretty clear that in pre-aryan times the country was covered by a huge tropical forest, jumed everywhere by the indigenous races called by the Aryans demons.

Thus the custom is actually older than the languages and physique we now see among the non-aryan hill tribes, who have been driven from the plains, and have since largely differentiated.

Neither the plough nor the hoe are non-aryan implements, and were they abolished, juming is the only alternative. Human customs are often unaccountably persistent, even after the causes are removed, but to understand juming, let us examine it where the custom is still a necessity, and where indeed it is a far more laborious system of cultivation than by plough or hoe. Taking the Noga* hills, as a good example, we generally see tribes, villages, or communities, owning and cropping in rotation an area from six to ten times that needed for a year's crop.

The hills around are seen in various stages of forest growth, or grass, where crops have been last taken off. It is also found on enquiry that each family has its land carefully marked out *by stones, ridges or gullies, on each of some six or eight different* sites, on the hill slopes around, and that are jumed in rotation.

This year's jume may be due east, last year west, and the year before to the south, and so on, a new site being cleared each year, and at first put under root crops, &c., called "No erra,"

NOTE.—Since writing the above, I see at page 94, Proceedings of the Royal Geographical Society—

"The Tanbunwhas of Borneo live a peaceful rural life, and have no very particular points of interest about them, it is their custom to move from one place to another on the banks of the river, building a very slight house, clearing the ground, and planting in an idle sort of way Paddy, Bananas, Indian Corn, Sweet Potatoes, and the like. Grass sooner or later makes its appearance, very slight attempts are made to keep it down. After a time (generally about 3 years from clearing) it has gained the upper hand, and the flimsy house about this time usually collapses, and move is made for a fresh location."

* The name is Noga, from Nok, and not Naga.

the second year under grain, and called "Heram erra," after which, as a rule, it is thrown up. The various sites are usually, though not invariably, taken in rotation, and when the forest growth is say eight or ten years old. On selection, the men and boys go to it and look up their boundaries, cutting or marking them, and at first clear all the undergrowth.

When this is done they fell the trees, leaving and lopping a few where they desire to train their pán, *alus*, &c., and cut the rest up so as to lie close, and thus burn thoroughly. After six weeks or so, and when sufficiently dried, it is all fired, giving rise to the huge vertical or columnar clouds with a spreading top so often seen in the hills in spring.

Men, boys and women then collect the stems, branches, &c., and burn round the stems of any large trees that it may be desirable to kill, or form of the sticks and logs an effectual abbatis to keep out animals.

In this newly cleared land they plant yams, *alus*, cotton, pán, kuchus, chillies, &c., and it is the "No erra." Last year's clearing is also cleared over by the dao, the creeper grass and plants cut down, and fired when dry, and in this they dibble the hill paddy, it is the "Heram erra."

As the season advances both sites must be weeded as grass springs up, and as may be supposed the rice gives some trouble, being so like grass, a little loop of bamboo, or an iron hoe the size of a table spoon is used in weeding.

The hill paddy is usually weeded three times, and on the hill sides may be seen, here a long line of women and girls, on another slope the men and boys, 10, 20 or 30 in a line, and the work is communistic. Thus one plot of ground gives, the first year, root crops, &c., the second year, hill rice, and is seldom planted the third year, as grasses come up so thickly, especially úlú (*Imperata cylindrica*), that rooting and growing underground defies entirely their limited agricultural implement, the dao.

In the fourth year, the site is generally dense úlú, through which one can only get by paths or on an elephant, here and there tree plants are up, also the larger grasses, as nol, kagra, megella, (*Saccharum spontanum*,) rising to 20 and 25 feet, (megella has measured 33,) creepers also appear, and some creeping grasses that rise over the úlú.

In the fifth year tree plants predominate, as there are no jungle fires known in these hills, and at last all trace of the ulú has disappeared by the seventh or eighth year, and the site is ready again.

Fire does not kill úlú, water and shade are the means most effectual, and hoeing, as a rule, on such slopes is worse than the disease, and the soil at times too stony. The roots or rather rhizome is often a foot deep.

The grasses of Eastern Bengal and Assam are about 170 kinds, and may be roughly grouped by their modes of propagation.

Forest grasses, the seeds of which are at a height to touch *animals* passing, and having spines, hooks, or gum as modes of attachment (when ripe).

Those of the open uncultivated plains, where the *wind* transports them, the minute seed being on a high kalm, and covered by down.

Again, seeds of grasses, that are like grain, and are transported by *birds*, others with light husks by *water*. Ulú has a minute seed on a kalm and fine down attached, which enables it to travel long distances, and when once rooted, another and unique mode of propagation at once comes into play, by its rapidly spreading *underground*, among stones and roots, or even to a depth of a foot and 18 inches in clay. It is this peculiarity of a grass, the seeds of which fill the air in myriads and travel immense distances, that lies at the root of the necessity for juming, among most hill tribes to the south and east of Assam, and also the north, where neither hoeing nor ploughing is possible.

Hill soils are proverbially rich, and exhausted soil is certainly not the cause, as we have cases in the adjoining plains where rice has been cropped for 200 years without intermission, or manure. The cure for juming is to introduce some other crop, like potatoes and plantains, where a much smaller area will support the same people, where the labour of cultivation can be *concentrated*

It is highly probable that juming survives in places where there is less need for it than formerly. But to suppress it by law, as a "barbarous system," would entail the necessity of our supporting all the hill people around Assam.

There is generally a good cause for everything, the above is one cause for the necessity of juming.

S. E. PEAL.

IV Notes, Queries and Extracts.

Mr. BRANDIS' SERVICES.

Notification.

His Excellency the Governor General in Council desires to place upon public record his recognition of the eminent services rendered to the State by Mr. D. Brandis, Ph. D., C.I.E., Inspector General of Forests to the Government of India, who has left India with the intention of retiring from the service of Government.

Mr. Brandis has served in the Forest Department since January 1856, and has for the last nineteen years been Inspector General of Forests to the Government of India. During this long period he has laboured incessantly and successfully to perfect the organisation and working of the Department in all parts of the country, and under his able administration the Forest revenues have risen from 35 to 95 lakhs of Rupees. The directions and instructions embodied in his numerous Inspection Reports and Reviews will for many years to come form the standard manuals for the practical guidance of Forest Officers. It is hoped that after his retirement Mr. Brandis will supplement the services he has rendered to the cause of Forest education in this country by assisting the Government at home to place the training of candidates for the superior staff of the Department upon a sound and permanent basis. The warmest thanks of the Government of India are due and are hereby tendered to Mr. Brandis.

Simla, 1st *May*, 1883.

EXPERIMENTAL TRIALS IN EXTRACTION OF FIBRES.

We note that experimental trials in the extraction of all kinds of fibres are to be made in Calcutta during the ensuing monsoons, in connection with the International Exhibition to be opened next December. The following are the conditions:—

2. Stems and other fibrous portions of fibre bearing plants or trees, and, as far as possible motive power, will be provided by Government for the use of intending exhibitors.

3. Machines or appliances should arrive in Calcutta about the 15th July, or 1st August, at latest.

4. Persons desiring to perform experimental trials should have their names registered at the office of the Revenue and Agricultural Department of the Government of India not later than the 30th June next, and should state on what fibrous plants they wish to ex-

periment, and to what extent in order that arrangements may be made for providing sufficient quantities of material to be operated on.

5. A list of plants suggested for trial is appended.

6. These experimental trials will be open to the public, and are likely to afford a favourable opportunity for inventors who may wish to make known their machines or processes, or to take out *patents*.

7. Any enquiries or communications relating to the contemplated trials should be addressed to the Exhibition Branch, Revenue and Agricultural Department, Government of India.

Scientific names.	English names.	Vernacular names.	Remarks.
Abelmoschus esculentus, ..	Okro, ..	Bhindi, ..	Found all over India.
" ficulneus, ..	Wild Okro, ..	Ban Dheuras, ..	Bengal, South India.
" moschatus, ..	Musk Mallow, ..	Musk Dana, ..	Ditto.
Abroma augusta, ..	..	Ulat Kambal, ..	Ditto.
Agave americana, ..	Aloe Fibre, ..	Hathi-chingár, ..	All over India.
" vivipara, ..	..	..	
Ananas sativa, ..	Pine-apple, ..	Ananas, ..	Bengal, South India.
Anona reticulata, ..	*Netted custard apple,* Bull's heart, ..	*Nona,* ..	*Bengal, Burma,* South India.
Boehmeria nivea and varieties, ..	Rhea, ..	Poi, ..	Assam, Tarai, &c.
Bauhinia racemosa, ..	..	Baki, ..	Forests all over India
" scandens, ..	..	Baki mahwal, ..	
" Vahlii, ..	..	Maholi, ..	
Butea frondosa, ..	..	Palás, Dhák, ..	All over India.
" superba, ..	..	..	Himalayan forests.
Calotropis gigantea, ..	Madár, ..	Madár ak, yercum,	All over India.
Cannabis indica, ..	Hemp, ..	Bhang, ..	Kumaun, Northern Bengal.
Careya arborea, ..	..	Kumbi, ..	Forests.
Cocos nucifera, ..	Cocoanut, ..	Nárikel, ..	Bengal, Burma, South India.
Corchorus olitorius, ..	Jute, ..	Pát, ..	Bengal.
Crotolaria juncea, ..	Sunn, ..	San, ..	North-Western Provinces and Bengal.
Grewia elastica, ..	..	Dhamin, ..	Himalayas and South India forest.
Hardwickia binata, ..	..	Acha, ..	South India.
Helicteres Isora, ..	..	Murorphali, ..	Central India.
Hibiscus cannabinis, ..	..	Patsan, ..	North-Western Provinces.
Hibiscus Rosa-sinensis, ..	..	Jaba, ..	Bengal.
Linum usitatissimum, ..	Flax, ..	Alsi, ..	North-West Provinces and Oudh.
Marsdenia tenacissima, ..	..	Babal Ják, ..	Central India.
Musa paradisiaca, ..	Plantain, ..	Kala, ..	Bengal, Burma, and South India.
Sansevieria zeylanica, ..	Lily fibre, ..	Marul, ..	Bengal, South India.
Urtica heterophylla, ..	Nilgiri nettle, ..	..	South India.
Yucca gloriosa, ..	Yucca fibre, ..	..	Ditto.

THE

INDIAN FORESTER.

Vol. IX.] June, 1883. [No. 6.

TRANSLATION OF M. PUTON'S AMÉNAGEMENT DES FORÊTS.

High Forests which are understocked.

General remarks.—A forest formerly treated by the regular High Forest method, with a rotation of 140 years, for instance, may have deteriorated owing to excessive fellings ; a redemption of rights of user, or a partition, may have divided its standing crop amongst several proprietors, so that it is no longer a regularly constituted forest, and yet the proprietor wishes to continue the former rotation. Without looking beyond the data we have before us, the problem appears to be insoluble ; it is just as impossible to adopt a rotation of 140 years as to manage a farm scientifically, without a proper rotation of crops.

Since the capital is insufficient, there must necessarily be a period during which we cannot exploit at 140 years ; but if we adhere to the definition, in which aménagement is explained as having for its object the determination of the annual yield, and the preparation of a table of fellings which will not lead to the deterioration of the forest ; it will be admitted, that the problem is readily soluble, and that it has an object which may be succinctly stated as follows :—

To draw up a table for the annual yield corresponding to the chosen rotation, and to fix the nature and order of the fellings which will be possible during the interval necessary for nature to produce a complete standing crop.

There will necessarily be two distinct phases in the working scheme, the one transitory, during which the produce will not be exactly of the kind the proprietor requires, and the other final, which will yield produce corresponding to the chosen rotation.

This transition period will be more or less prolonged according to circumstances, it may only be a *temporary phase* in a final

working scheme, or a *transition period* preceding the working scheme, or finally a *conversion rotation*. The cases which may occur are indeed very numerous, and before going too far, we must establish an important distinction between them. Among forests, where the standing crop is insufficient for the high forest method with the rotation the proprietor has chosen, we may have to deal with the following :—

A. Forests which have always been managed as high forests, or which, as in the case of conifers, cannot be treated in any other way, but have deteriorated owing to excessive fellings : to this case old foresters applied the term *restoration to high forest.**

B. Forests which have always been worked as coppice, and which are to be converted into high forests.

I will first deal with forests which come under A, and then with *conversions*, which involve special rules and combinations.

A.—*Restoration of High Forest.*

I assume that the proprietor has fixed the rotation, *i.e.*, that he has decided to produce timber of a certain age, 120 years for instance ; I further assume, that the detailed description of the forest has been made, and shows that the proper gradation of ages in the standing crop is defective : there will then necessarily be a transition period, before we can commence fellings in accordance with the chosen rotation.

In the transition period, it may be arranged to exploit certain areas prematurely, or else to glean produce here and there throughout the whole forest area ; this period will be, as we shall see below, either a special transition period anterior to the working-scheme, or simply a *phase* in the final working scheme.

But whatever may be its character, it will always be easy to fix its duration ; at 20 years, 40 years, according to the age of the older trees, and their place in the final working-scheme. This consideration will necessitate the marking out the boundaries of the periodic blocks on the ground. We have all the data for this : the length of the regeneration period, which depends on the climate, and the species, and the description of compartments which has been made as an estimate of the resources of the forest.

We must, therefore, first of all, draw up the final working-scheme. This is necessary, not only for the considerations which I have just mentioned, but also for those which I have explained in the corresponding chapter on coppice.†

* This expression (*reconduction en futaie*) is no longer used in Forestry, and we introduce it, not to restore it as a *technical* word, but in order more clearly to characterise situations which often occur in Hill Forestry.—(AU.)

† Page 9, Vol. IX., "Indian Forester."

When once the general plan of exploitation has been established, that is to say the blocks marked out on the ground according to the working scheme, there are two ways of proceeding.

The former consists in determining the duration of the transition-period according to the age requirements, and to arrange the oldest standing crops in a first periodic block with a rotation which will be preceded by a transition period.

In the latter, instead of placing the oldest crops, called by foresters the *head of the working-scheme*, in the first periodic block, with the proviso that they shall not be exploited till after a transition period of 20 or 40 years; they are placed in the second or third periodic block, according to the delay that may be necessary. The transition period must, therefore, be equal to one or two ordinary periods of regeneration. The first, or the earlier periods of the working-scheme, are the transition periods we have referred to; in them the regeneration which may have been commenced in certain areas is completed, or premature fellings are made in others, or produce is gleaned here and there throughout the whole forest area, and without reference to the proper order of fellings.

Of these two methods, the former may be called general, in that it may always be applied; the latter will only suit a particular case, though one frequently met with, for, considering the impossibility of determining precisely the duration of the periods of regeneration or transition, it is often possible to make them equal.

Thence the advantage accrues of at once commencing the regular order of fellings, a matter of considerable importance, for we then avoid the disorder of a special transition period, and obtain the advantages of simplicity, and of impressing a definite character on each felling. If, for instance, a selection felling of old trees is urgently required in a compartment of the first periodic block, no forester would hesitate to call it a more or less protracted final felling; if it must be made in the fourth periodic block, none would hesitate as to the manner of exploiting, or as to the class of trees to be removed, for we are working according to the table of fellings. With a special transition period of say 40 years, one is obliged, in order to recognise the character of each felling, to make a calculation which is doubtless very simple, but which may lead to errors, and omissions, and their effect is always greatly prejudicial to the object of the working-scheme. Finally, in important forest operations, we enjoy the benefit of introducing a uniform system, which is in unison with the administrative control of the forests.

The produce of the first periods of the working-scheme is in this case, as in preceding ones, composed of two elements: produce from the ordinary fellings, which may indeed be hardly worth mentioning, and produce from extraordinary

fellings: these latter are taken from all parts of the forest, and form the principal produce of the transition period.

We shall better understand this theory which I have endeavoured to generalise, after considering some examples. When (on page 228, Vol. VIII., "Indian Forester") I spoke of the capital of exploitation, I was careful to explain the meaning of this term: the forest should not only contain standing crops, corresponding to a gradation of ages from 1 to 120 years, but this volume should also be distributed in regular succession of ages over the forest area. Let us suppose for instance, a forest of 300 acres of regular poles, and of a uniform age of 60 years which has just been thinned; we should have our capital of exploitation constituted, in so far as the volume of a uniform standing crop of 60 years is equal to that of a series of properly graduated standing crops from 1 to 120 years; but this forest would not be constituted for immediate high forest treatment with a rotation of 120 years, for the oldest timber has not attained this age, and the trees cannot even be relied upon to yield seed sufficient for complete reproduction. To take another example, we will suppose a forest of 300 acres containing a small area of young high forest 80 years' old, and 250 acres of young 20 years' wood, under more or less numerous mature trees, (young growth in which final fellings are urgent): we have here a forest of which the growing stock is neither constituted by volume nor by age gradation.

In order not to bewilder the reader by considering the numerous cases of irregular forests, whose restoration is desired, I will only consider two examples.

First Example.—300 acres of regular beech which has just been thinned, 60 years' old, and which is to be worked as high forest with a rotation of 120 years.

If we allow the stock to grow up for 60 years in order to attain the age chosen for exploitability, we shall get a forest every where stocked with timber 120 years' old, with the result that the proprietor will get nothing but thinnings from his forest for 60 years, and then obtain an excessive supply, an unnecessary luxury for which he has to pay by years of privation.

A large forest proprietor, such as the State, could combine the management of this forest with others, and allow the stock to mature, contenting himself meanwhile with a few thinnings; but under the terms of the problem, *i.e.*, the forest being considered by itself alone, it would be more in accordance with the proprietor's interests to commence the regeneration at once.

But, at 60 years' of age, beech does not generally yield sufficient seed to regenerate the forest. In spite therefore of the expense of artificial plantations, it may be worth while resorting to them in preference to the sacrifice incurred by drawing no income from a forest which is already of considerable value. We

shall then employ the method of artificial regeneration fellings, called *shelter fellings*, because the trees are thinned so as to afford suitable protection for the germination of artificial seed, and are removed gradually in accordance with the requirements of the seedlings.

Supposing the period of regeneration fixed at 20 years, the following scheme might be adopted:—

1st Period.—Artificial regeneration of the 1st and 6th periodic blocks.

2nd Period.—Natural and artificial regeneration of the 2nd periodic block. Thinnings over $\frac{1}{20}$th of the area in the 3rd, 4th and 5th periodic blocks.

3rd Period.—Natural regeneration of the 3rd periodic block. Thinnings in the other blocks.

4th Period.—As above.

General Table of Fellings.

I.	50 acres,	60 years,	..	1880-1899,	70 years.
II.	50 „	60 „	..	1900-1919,	90 „
III.	50 „	60 „	..	1920-1939,	110 „
IV.	50 „	60 „	..	1940-1959,	130 „
V.	50 „	60 „	..	1960-1979,	150 „
VI.	50 „	60 „	..	1880-1899,	70 „
				1980-1999,	110 „

Special Table.

I. Extraordinary produce—(*a*), fellings by volume.

VI. 50 acres, 60 years—Shelter fellings; (*b*), fellings by area, *Nil.*

2. Ordinary produce—(*a*), fellings by volume.

I. 50 acres, 60 years—Shelter fellings; (*b*), fellings by area, *Nil.*

Second Example.—Forest of 300 acres, of which 50 acres are stocked with young high forest of beech, and the remainder with young wood, 20 years' old, under old beech and silver fir more or less numerous.—Rotation, 120 years—Period 20 years.

In order to be more precise, the description of compartments follows:—

			Years.
A.	25 Acres,	regular young growth, ...	20
B.	75 „	seedlings and saplings with irregular high forest, ...	20 to 130
C.	50 „	young high forest, beech and silver fir,	30
D.	12½ „	saplings and poles, beech, ...	20
E.	37½ „	poles with scattered trees of all ages,	20 to 130
F.	50 „	poles and saplings, silver fir, ...	20
G.	15 „	final fellings required, ...	20 to 130
H.	35 „	blanks, planted up, ...	3
	300		

The principle of the working scheme will be to place C. in the 3rd *periodic block*, and *to distribute the remainder of the forest* in the other periodic blocks.

The two first periods will have a transitional character, and throughout their duration we shall obtain produce from selection fellings in the young crops.

In the 1st period, the produce will consist of selection fellings of the oldest trees, and *from final fellings.*

We must be careful to economize these resources, so as to leave sufficient produce for the second period, for which we shall reserve the thinnings, preparatory regeneration fellings, and selection fellings of trees which can remain without too much injury to the young growth. Not till the 3rd period shall we operate on the little block of high forest which is now 80 years' old, and the regeneration of the young crops, of which the mass of the forest is composed, will not commence till the 4th period.

General Table of Fellings.

Numbers		Areas, in Acres		Actual age in 1880.	Period fixed for felling.	Age at time of felling.	Remarks.
Of Periodic blocks.	Of Compartments.	Of Periodic blocks.	Of Compartments.				
I.	a	50	25	20	1880–1899	...	
	b		95	20 130		140	
II.	...	50	80	20–130	1900–1919	140	
III.	...	50	50	80	1920–1939	130	
IV.	a	50	12½	20	1940–1959	90	
	b		87½	20–130		90	
V.	...	50	50	20	1960–1979	110	
VI.	a	50	15	20-130	1980–1999	130	
	b		35	3		113	

Special Table of Fellings, 1880-1899.

Compartments.	Area.	Description of standing crop.	Actual age in 1880.	Nature of fellings.	Extent of fellings by [redacted]	Remarks.
		§ I. EXTRAORDINARY PRODUCE.				
		A.—*Fellings by Volume.*				
II.	50	Young growth with irregular high *forest*, ...	20–130	Selection fellings of the oldest trees,	...	
IV*b*.	37½	Same, trees of all ages,	20–180	Do.	...	
VI*a*.	15	Complete young growth under mature trees,	20–130	Final felling,	...	
		B.—*Fellings by Area.*				
...	...	...	...	...	*Nil.*	
		§ II. ORDINARY PRODUCE.				
		A.—*Fellings by Volume.*				
I*b*.	80	Young growth with high forest, ...	20–130	Final felling,	...	
		B.—*Fellings by Area.*				
...	...	...	...	...	*Nil.*	

Capability.—The produce to be exploited in the 1st period is as follows:—

II, ...	3,600 cubic mètres	*7,380 cubic mètres,*
IV*b*, ...	930 „	
VI*a*, ...	390 „	
I*b*, ...	2,460 „	

or 369 cubic mètres per annum.

Estimate of the volume which might be realised if the forest were regular (by comparison with neighbouring forests), ... 10,000 cubic mètres.

Difference, ... 2,620

CRITICISMS ON "NOTES FOR A MANUAL OF INDIAN SYLVICULTURE"

Owing to want of leisure I have, much to my regret, to abandon my original plan of giving a few brief remarks of my own, by way of remark or explanation, after each objection or suggestion brought forward by my critics, who, I trust, will not in future be offended at my leaving many of their objections unanswered.

Major Campbell-Walker.

The remarks of Major Campbell-Walker which follow were received many months ago, but have not been published before, as they formed part of a private communication, and it is only recently that permission has been received for their publication.

1. "I may state, as you ask me to do so, that I at once noted many definitions which I consider un-English and conveying no meaning to the English mind. 'Canopied' forest is surely better called *close* or *closed*. 'Stool-shoot' is surely better as *coppice-shoot*, and *coppice-sapling* better than 'sapling on the stool'!

2. "Then in my opinion your definitions of saplings, poles and trees are far too arbitrary and require modification to suit our extremely rapid growth of Australian Eucalypti, Acacias and Casuarina, many of which are still saplings when far more than 12 inches in diameter and having shed their lower branches, and trees long before they have attained their full length of bole."

Yes, this is very perplexing. Would some one kindly suggest some classification less open to objection?

Kad Handi.

"The following points strike me on reading through the criticisms in the last two numbers of the 'Forester':—

1. "I should agree with you against Mr. Smythies in preferring the words 'coupe' and 'régime,' but not as regards 'fall.' We have, falls of snow, falls of rain, and the Israelites got a fall of manna; there are falls on the ice, falls on orange peel, and windfalls for men and for trees, but really, to talk of a fall of timber will take people to the clouds and keep them there.

2. "I like to spell *cover* with a 't' at the end, and have been in the habit of doing so when the word was used in its technical forest sense. 'Covert' is a woodman's term, and I imagine simply the Norman-French form of our youthful friend '*convert*.'

3. "'Top' is certainly more intelligible than 'top off.'

4. "I am converted to your way of thinking about 'exploit' and its derivatives.

5. "I differ from you about the necessity of dropping the very expressive term 'shade-loving,' nor do I think your reasoning logical. You admit that shade is not darkness but partial light. Now, a host of plants and trees love partial light, *i.e.*, shade, and only thrive under these conditions: also, instead of avoiding light, they grow towards it. Place a fern between sunlight and shade, and it will send out a

frond into the sun, which will be presently withered by the excess of light.* You would not deny that it was correct to say of a plant that it loved a cool climate. 'Sandal *loves* the cool climate of the highlands of Southern India.' Coolness is a tempered heat exactly as shade is a lessened light. It is quite as correct and more expressive to say that Sandal *loves* a cool climate than that Sandal *avoids* a hot climate. Physiologically, heat is as necessary to plant life as is light, and the parallel seems exact.†

"Again your illustrations do not appear to me to illustrate your point. Surely *Hardwickia binata* can be light-loving and yet stand shade exactly as Sandal is shade-loving, and yet stands a complete exposure to sun-light. And it is confusing to mix up in your explanations *shade* and *shelter*. One finds ferns most developed in climates where there is nothing to fear from either frost or drought, and yet this nowise alters the distinct shade-loving character of these plants. Provided there is shade (*i.e.*, a subdued light) from overhanging rocks, mountain mists, &c., ferns will be found flourishing in situations too shelterless and exposed for tree life. In artificial ferneries half the light is usually screened off artificially: substitute a frame of glass,‡ a far more *complete* shelter, and the result is commonly cucumbers!

"I prefer *shade-bearing* to *shade-suffering*."

I really cannot see what there is confusing in distinguishing *shade* from *shelter*. KAD HANDI has unconsciously been arguing against himself and *entirely in my favour* by adducing the instance of ferns. He could not have shown more clearly than he has done that these plants require shelter against frost, drought and other inclemencies of the weather, but do not object to a strong light as long as they have this shelter. Moreover, his choice of ferns as illustration for his argument is rather unfortunate, as the fronds of ferns and the cotyledons of conifers are only known instances of vegetable organs developing chlorophyll in complete darkness.

6. "I agree with W. R. F. that *Eugenia Jambolana* should be described as an evergreen. In the dry climate of Mysore it is a common roadside tree, planted expressly because it is an evergreen. I do not mean to say that in exceptional situations where the sub-soil moisture might be cut off, as above massive gneiss for instance, the tree would not be bare for a short time. I can recall having seen the tree bare, but it is exceptional."

Does not the exception prove the rule?

7. "I agree with Sw. about shrubs and trees. I should describe a shrub simply as breaking up into branches, below breast high or 5 feet, the point where a standing tree is girthed. Practically this is what it comes to in estimating the Form-factors when measur-

* Kad Handi would be more accurate if he said "excess of heat." *Excess of food* would kill us, but are we, therefore, *hunger-loving?*—E. E. F.

† Quite so, and therefore I do not use the term 'light-avoiding.'—E. E. F.

‡ Is glass any shelter against the heat rays of the sun? The confusion in KAD HANDI's mind as regards light and heat is truly delightful.—E. E. F.

ing standing stock. A tree forking can be measured by girthing each trunk separately as they occur at 5 feet above the ground, and making some allowance when applying the Form factor in use: but some trees (Casuarina sometimes on dry uplands) are simply shrubs, stemless from the ground upwards. They may be largish trees, but their form is that of a shrub. I have seen Casuarinas of this shrubby form both near the Madras Coast and on the Mysore plateau upwards of 40 feet in height. To measure them for firewood, a distinct series of Form-factors must be used expressed in terms of the girth at the ground level. This gives considerably extra trouble: no one who has experienced it is likely to forget the practical difference between a shrub and a tree. I use the term 'Form-factor' as applicable to the whole tree in the sense that 'Reducing factor' is applicable to the bole. Thus a shrub can only have a Form-factor, a tree has a Form-factor and a Reducing-factor, and one or the other will ordinarily be used as the marketable value of the tree is as firewood or as timber. A Reducing factor is always a fraction, a Form-factor varies between 0·30 (rarely 0·20) and a small fraction above unity. For Blue-gums and Casuarinas, *the* two firewood trees of Southern India, the Form-factor is ordinarily not very far removed from 0·50. This is a digression. I must defer suggestion till I have finished criticising the terms included in your definitions."

We *must* have a limit of height for a 'shrub.' I have seen plants 150 feet high, which forked at 2 feet from the ground, each new trunk girthing at least 5 feet. Are such plants *shrubs?* Since answering Sw. I find that Sir Joseph Hooker also limits the height of a shrub.

8. "By 'bole' I should with you have understood 'clear stem,' otherwise stem and bole come to the same thing. We give trees boles by pruning or close planting. The stem of a felled tree may be cut up in various ways for timber, but then I think all idea of 'boles' ceases and we get to logs.

9. "In place of 'Fall,' which Sw. also objects to, would there be objection to continue to use the words 'felling' for timber and 'cutting' for firewood. 'Yield' I dislike on account of its vagueness. Applied to a forest it includes such things as honey and elephants. In certain inaccessible forests this may be the only yield. Reserve is undoubtedly 'highly objectionable' in the sense in which you propose to employ it. I have used the words 'standards' and 'coppice-under-standards' for the last ten years, and I should imagine no terms had a more established currency.

10. "*Light-demanding* or *Light-loving* would I suppose be equally clear; the latter seems preferable.

11. "Is there anything to be gained by endeavouring to substitute 'regeneration' for 'reproduction'? 'Regeneration' smacks very much of theology in English, while 'reproduction' is one of those words *understanded* of the people which it is very undesirable to endeavour to replace. Talk to a Revenue Officer of the natural reproduction of a forest and he will understand you. Begin on regeneration and he will glance at your pockets for tracts."

The word 'regeneration' has been in use in India for the past 15 years certainly, and it is in current use in England (*lege* "Journal of Forestry.")

12. "On first reading your definitions I resented the word 'epicorm.' Shortly afterwards in describing a Casuarina plantation I found myself using it unconsciously. It is expressive and supplies a want.

13. "I must join emphatically in the protest that has already been raised against the use of an utterly* unknown word for such a common tree as *Acacia Catechu*. What could be neater to your hand than 'the *Catechu-Acacia*' if you want to give a colloquial name to a common tree. If you persist in this ugly duckling, you must tell us how it is to be pronounced, whether as the English word 'care' or whether 'khair' is phonetic spelling.

14. "I notice you do not approve of the abbreviations of *Dicotyledon* into *Dicot* and *Monocotyledon* into *Monocot*. Might not the abbreviations (which I believe are current to a considerable extent among practical men) be inserted in brackets.

15. "I agree with the criticism that has been made that 'gregarious' and 'social' would be liable to be confounded. Would not '*associative*' be less liable to be misunderstood than social. One talks of teak, &c., never forming pure natural forests, but growing always '*associated*' with other species.

16. "As a general criticism, I would offer the remark, that looking at the arrangement of the valuable matter in your 'Sylviculture,' there is too much heading and sub-heading, with back references through series of numbers great and small. At page 7 for instance, under III*d* (it is very like a Budget ! !) we have an enumeration of injuries caused by fire, each injury numbered; then below, the reasons of the injuries with numbers to correspond. Could not the reasons follow the injuries, and thus do away with two sèries of reference figures? I must admit, that on reading the pages through I have not grasped the principle on which the information is arranged. In a book of reference the *sine quâ non* is to be able to lay one's finger on a point at once, is it not? It would facilitate reference if the subject of each chapter could be printed at the *head of each page, and if all general information preceded the* descriptions of classes of forests and individual species."

It has always been my intention to do this when the Notes are printed as a separate book.

17. "With regard to the enquiry about fires in Littoral Forests (page 78). If the Casuarina plantations on the Madras Coast are put in this class, then fires do occasionally occur, even when the tree is growing on pure shifting sand, and there is nothing but the tree's own leaf-deposit to burn, but they are very rare. I have seen a quarter of an acre in the middle of a Coast Casuarina plantation killed by fire. The fire was of the lightest character, but Casuarina

---

* The name used by more than two-thirds of the population of India is surely not an "utterly unknown word."—E. E. F.

is extremely sensitive to fire. If the Casuarina plantations on the Madras Coast are to be classed 'Littoral,' where will you put the equally fine plantations of Casuarina on the highlands of Mysore, where the tree flourishes wherever there is moderate moisture up to 5,000 feet? In point of appearance there is nothing to choose between the best planting in both localities. You will be able to draw your own conclusions from the figures of growth which will shortly be published, but practically the class of forest is the same whether on the coast or inland.

18. "I doubt if the distinction of cold weather leaf-shedders and hot weather leaf-shedders is useful in low latitudes in India, where the cold weather and the hot weather merge into the dry season. In the central hill forests in Mysore, the time when there are most trees without leaves, is between the cold weather and the hot weather in March, when the dry N.E. wind is strongest, and this season coincides, or follows by about a fortnight, the most dangerous period of the fire-season. Many trees are evergreen all through the dry season, most trees in places where there is subsoil moisture. Some leaf-shedders get their leaves earlier than others, but I think quite independently of the 15° of mean temperature which marks the difference between the cooler and the warmer weather. In the lower, drier, hill forests, *Hardwickia binata* is the first in leaf. It is usually in all the beauty of its young foliage in the early part of March or the second fortnight in February, and suffers in consequence from fires. *Boswellia thurifera*, its most common associate, loses its foliage later, but irregularly, depending on subsoil moisture. These two species characterize the drier and hotter of the central-hill forests; there are tracts where these species are gregarious. Would you call this class of forest 'cold weather leaf-shedding' or 'hot weather leaf-shedding'? I see you class *Hardwickia binata* forest as hot weather leaf shedding. It is in Mysore the only tree I can recall as a distinct cold weather leaf-shedder. *Schleichera trijuga* in the western teak forest of Mysore comes into leaf when the hot weather is about half over, *i. e.*, later than *Hardwickia binata* in the hill-forests. These two species are remarkable as the first in leaf in their class of forest.

"I may mention, that in the central hill forests in Mysore, in a locality where teak and *Hardwickia binata* occur, either gregarious, or associated with other trees, teak occupies the cool moist upper regions of the hills, *Hardwickia binata* and *Boswellia thurifera* the lower portions swept by the dry wind from the plateau, Sandal being scattered here and there over the whole area, anywhere where there happens to be natural or accidental protection from fire. This distribution is well marked in the Cauvery forests (about 120 square miles) on the southern frontier of Mysore."

In Central India, including the Khandesh District of Bombay, *Hardwickia binata* loses its foliage at the end of March or beginning and even middle of April, while the *Boswellia* is leafless by the end of December. If in Southern India the *Hardwickia* sheds its foliage in February, then I must alter my classification or introduce some remarks to that effect.

19. "At page 91—is 'direct' as clear or as descriptive as '*in situ*'

sowings; also, I think '*in situ* sowing' is the more common expression. In what follows with regard to nurseries and planting, I differ from you on many fundamental points. Different systems are suited to different localities. On the Madras Coast, Casuarina planting appears to cost about four annas per established tree, whether in private or in Government plantations; in Mysore the cost is from one anna to one-and-a-half annas depending on seasons; one-and-a-half annas is the cost of planting a pitted area twice over. In Madras there are no pits, in Mysore there is no watering; in the former most of the expenditure is for watering; in Mysore for pitting. I look on the perfection of planting as that in which the nursery plant can be taken out of the nursery and planted where it has to grow *without any change of conditions.* One has much to unlearn of what one has seen in Europe of planting in easy moist climates."

Does KAD HANDI mean that if a certain species is selected to be cultivated in a given locality and soil, in which its growth is slow and languishing, we must plant out weak, miserable seedlings raised in a similar locality and soil? What is then the use of nurseries? Why not *always* sow *in situ,* for that would be the very perfection he aims at? Under no other circumstances could a "change of conditions be avoided."

MR. PREVOST.

"On page 402 of the 'Indian Forester' for December 1882, you state two facts, which, allow me to explain, are not quite correct.

1. "Goats swallow Babul seeds, but when chewing the cud *eject* the seeds and do *not pass it through their stomachs:* this is only done by cows and buffalos. I have had 2,000 goats out daily in my Babul Bans, and agree with the villagers that the seed falls from their mouths and does not pass through them.

2. "Again fire often ravages the Berar Babul Bans. As a rule, the Bans are the grazing ground of the village and, therefore, all grass is gone by the hot weather. Hence their comparative immunity from fire. But I had two small fires this year in my Babul Ban, and formerly, when this Ban was a District Forest, it often was burnt. All the Bans in Berar have a dense growth of very coarse grass and weeds in them."

E. E. FERNANDEZ.

A JOURNEY THROUGH CHAMBA.

(Continued from page 20).

8th July.—To Bhandal, about 9 miles. A very pleasantm arch all along the valley of the Siul just above the river, the road being never very far away from the water, and with the pleasant roar of the stream sounding in our ears. There is what is called a "Forest House" at Bhandal, but "hut" would be a more appropriate term, as it only consists of two small rooms, nothing else; not even a bath-room, and as the walls are plastered with

mud, the place does not look inviting at present. There are a few grand, rugged deodars near the house, very gnarled and crooked, and the place is the abode of a Devi, for just in front are two large "lingam" stones. There was a fine stone bull here till a year ago, but a French traveller simply stole it, there is no other term, for he just packed it up and took it away. I have no doubt it will adorn his family mansion with some charming story attached to it. Immediately after our arrival we went down to the stream below and had our usual bathe, there was a fairly deep corner, and as the water was not at all cold we enjoyed it very much. While dressing, a deputation waited on us, and requested the honor of our presence at a great wrestling tournament, which was just about to commence on a pretty little maidan on the other side of the stream. A stalwart Cashmiri, one of our Timber Contractors, carried us over on his shoulders, and we seated ourselves on the grass and waited for the business to commence. At first we did not take much interest in it, as it was the usual slow native wrestling, head to head waiting for a chance, or else one man sitting on the ground and the other holding him tightly round the waist trying to heave him over on his back; but we soon began to know the different competitors by sight, and to become interested in the different struggles. We enquired into the history of the tournament, and found it was a gathering of the clans of the Bhandal Valley, a sort of athletic meet "promoted" by a person whom they called the "Mali," who was giving the prizes. There were regular heats, the loser dropping out of the contest. After a time it became evident that the "cracks" were two fine men, by name Jhámprá and Samdá, whose history we learnt. Jhámprá, a middle aged man, with long hair, a very hairy face, and a "corrugated" brow looked not unlike a bear; he was a blacksmith by trade, and had at one time been the cock of the walk, and taught the young men; in time, however arose, or rather grew up, Samdá, an artist in pottery, otherwise a *ghurra* maker, a very fine young man, face quite smooth, fine build of body; and he, having learnt the science from Jhámprá, and having youth and activity, overthrew the old champion. As popular talk went Jhámprá would rather not meet Samdá, this served to give us quite an interest in the affair, and we at once offered two prizes, one for winner the other for loser if they would "try a fall." There was some diffidence on the part of Jhámprá, who had a sprained thumb, but at length, having gone through the usual ceremonies, of eating a little earth, putting their caps on the ground and shaking hands as in the "ring," the battle commenced. They had different modes of engaging; Jhámprá would go back about a dozen paces, then come running up sideways till he got close to his opponent, and flop down into a stooping attitude with his hands on his knees; Samdá merely stood and waited. I suppose

they were at it for three or four hours, sometimes exasperating us by the patient way in which one strove to get a good grip, and the other merely undid his hands, after a good deal of this Jhámprá suddenly dropped on the ground, and by a movement quick as lightning, hurled Samdá over on his back, but the latter was like an eel, and as he fell, managed to turn, so that only the outside of one shoulder touched the ground, I was referred to but gave it as no fall, it being necessary that both shoulders should be on the ground. They began again, but though we stayed till nearly dusk, neither had gained any advantage. I promised, however, to make Jhámprá a present, as he at any rate had obtained a "try." There was an amusing incident besides the above; a nice looking young man with a comical expression of face, entered the arena, and noticing his likeness to a friend, we dubbed him "Ker" at once; well, opposed to "Ker" came a strange figure whose appearance seemed familiar to me, and it turned out to be my peon by name Sohun, he is a Muzbi Sikh, and has hair about 2 feet long, and wore a puggri to keep his flowing locks in place. He and "Ker" engaged much to the amusement of all, for Sohun's puggri, every now and then came off and down came his hair; there was no fall on either side, but it seemed to me that "Ker" was only playing with him, so I called him aside and offered him a rupee if he would throw Sohun, who was vapouring to some bystanders. "Ker" at once ran back into the ring, and peremptorily called to Sohun, and at it they went; in about two minutes he had Sohun with his back downwards, but holding himself clear of the ground, and vainly endeavouring to save a fall, but "Ker" simply sat on his chest and flopped him down with both shoulders touching the ground, we gave "Ker" his rupee to his great delight, and then went back to the house, having enjoyed ourselves immensely.

To-day I found for the first time *Asplenium ceterach* and *A. japonicum* and *Osmunda regalis*, barren frond only, as the fertile frond dies down early in the summer; it was growing on a rock on the river bank below Bhandal at about 5,500 feet. Next day we marched to the village of Pringal, where our tents were pitched on the roof of one of the village houses, as there was no flat space available anywhere near. I had often heard of this, but never quite believed it till now, it was a very good encamping ground, as it happened to be rainy weather; had the sun been out we might have found the village odours rather overpowering, as it was, we were very glad to be on such a well drained place. The road from Bhandal to Pringal is very pretty, a change of scene almost at every corner, but it is rather an exasperating road, as it goes up and down in the most purposeless way, sometimes dropping down very steeply only to ascend as steeply, simply to avoid a rather large stone; any hill pony can

go over it with ease and safety. On the way we went up into the Chadbent Forest to see some logging works, and one thing that struck me was there being no necessity to bark deodar trees at felling, for every particle of bark is rubbed away in the descent to the water's edge. There are some fine ash (*Fraxinus floribunda*) in this forest, of which we have cut a few for the Lahore market, but the wood is so heavy, that I fear it will be a long time before the treacherous Ravi yields up the logs at the Shâhdara Depôt.

We saw our first bear to-day, and this fact will, I think, show that they are not the common "blackberries on every hedge" that some people try to make one believe; here have we been tramping for three weeks over all sorts of country and never caught a glimpse of one; I do not say we ever tried to find one, but still, considering the extent of country we have covered, we should have seen some were they so very common. Our bear happened to us in this wise—we had just come in from Bhandal and settled down comfortably for the evening, when on the opposite side of the stream my eye caught a small black object among the tall balsams; I thought it moved, but was not certain, and lazily regarded it, after looking for about ten minutes I felt sure it moved, and presently in ran an excited guddi with the news of a bear, and showed me my black spot; we huddled on our clothes and boots as fast as we could, and ran down to the stream and across; then a pumping pull to a spur above where we had seen the bear, there he was, sure enough, but rather indistinct in the darkening daylight, among the tall balsams; we tried to get nearer, but the ground and jungle would not admit of it, so there was nothing left but to "draw a bead" on "friend bruin," (as the writers in the "Asian" have it,) and as I was firing with a smooth bore at sixty yards, I had to aim carefully; I hit him, but saw that he went away, however I ran to the place and found blood, which we tracked for some distance, and then had to give up as it was nearly dark; as luck would have it, this was the only day on which I was without a rifle; I had carried it with me every day till we got to Bhandal, and had become so sceptical of bears, that I left it at the Bhandal Forest House! Along the road from Bhandal I saw a good deal of *Osmunda regalis*, but nothing except barren fronds.

Next day (10th July) we left our camp standing at Pringal, and walked up to within 3 miles of the Padri Pass, the road is a very fair one, passable for ponies all the way, but is very uneven. It rained heavily at times during the day, but cleared again. The forests up the Bhandal valley, lying as they do near a fair floating stream have been nearly cleared of all good trees, and will require much time to recover. We saw another bear to-day, a long way off on the opposite side of the valley, much too far for us to go after him. The ferns near Langera and above are very

good, especially in a damp corner under a cliff just under the village. I found in one spot *Osmunda Claytoniana; Polypodium phegopteris; Athyrium fimbriatum; Aspidium Thomsoni; Lastrea sparsa;* and a variety of *A. Filix fœmina*—higher up towards the Pass some very fine *Cheilanthes subvillosa* and *Cystopteris fragilis.* I have not yet found *Asplenium viride,* at which I am rather surprised, as I fully expected to get it about this part.

Next day we retraced our steps to Bhandal; the day after, a long march into Manjir, where lives the ex-Raja of Chamba, Gopal Singh, who was deposed by the British Government in favor of his son, Raja Sham Singh, who is at present a minor. The road from Bhandal to Manjir is very fair to the crossing of the Siul river, then there is a rather tiring pull to the top of the range, and then a vile road down to the village of Manjir.

On the 13th I went back to my head-quarters Kalatope. From Manjir, there is an excellent road along the river to a fine wooden bridge across that, and then at an easy gradient up to Pokri. I rode so far and walked the rest; at the bottom of the hill below Pokri I found a new fern (to me), which has been pronounced by the Kew authorities to be *Notholæna vellea;* I missed it on my first journey this way, and yet it is quite common here. After leaving Pokri I went down to the river Ravi and crossed on "mussucks," and then took a bee line up to the Chil Bungalow, and home through the Kalatope forest. I expected to find the usual "drais" or "sarnai" with a charpoy at the river to take me across, but was disagreeably surprised to find only a big mussuck, and on this I had to lie somehow with my feet dangling in the water; however it was a novelty, and that is something to be thankful for. I reached home by 3 o'clock in the afternoon, after a very hot and tiring walk through Chil forests.

Since writing my journal I see a letter from "B. P." asking me about the "*Rhus punjabensis.*" He is, I think, right in what he says, but the names are so puzzling, that I am not yet clear which is *Pistacia* and which *Rhus,* and must look out *for the flowers this year (1883). The local name for Pistacia appears* to be "Kakkréran," for no one seems to understand "Kakkar." I am now disposed to think that all the trees I have noticed are *Pistacia* and none *Rhus punjabensis.* I have seen a good deal of Pistacia wood in Chamba, and its color seems much lighter than the Simla wood; it takes a beautiful polish, but is certainly given to warping as "B. P." points out.

J. C. McDonell.

THE BALSAM.

This favourite annual is one of the best we have for brightening up our gardens in the rains, and during the flowerless months in the beginning of the cold season. The wild species, *Impatiens*

Balsamina, from which our garden varieties have sprung, is a native of India, and is principally found growing in damp, shady places in the lower Himalayan valleys. The wild plant has a beauty of its own, but from a florist's point of view it is not to be compared with the variously colored, double flowering cultivated varieties. It is grown in most of the European and Native gardens throughout the country, but unless the plants have been raised from imported seeds, the varieties met with are not far removed from the wild species. It is possible to raise plants from Indian grown seed with flowers little inferior to those of the best Camellia and Carnation flowered varieties of European nurserymen's catalogues, and as raising one's own seeds is a pleasing and profitable occupation, I shall, further on, describe the most certain method of securing a strain of good acclimatized balsams. The coarse weedy strains will exist without any care or trouble, but in order to have well grown plants of good varieties in flower from July until November, a little attention has to be paid in selecting the dates for sowing, and also to their treatment during progress of growth.

The first sowing should be made in the beginning of June, and continued every fortnight until the beginning of September. The seed pots should be kept under the shade of a tree, or covered by mats or any suitable shading material until the seeds germinate. As soon as they have germinated, shade should be gradually withdrawn until the seedlings are able to stand full exposure to the sun. When the seedlings are two or three inches high, they should be potted singly into small pots, and again shaded for a day or two until they have made fresh roots. In the course of ten days or a fortnight they will be ready for a shift into a larger sized pot, and the same process should be continued until the flower buds begin to appear. In order to have good specimen plants, three shifts should be given during their progress of growth, but if time cannot be spared, and if the proper sizes of flower pots are not to be had, only two shifts need be given. It is a good plan to see that the malli does not neglect to shift them as soon as ready, and that he uses the proper sized pot. As a rule, when left to his own devices, he will transplant them from the seed pot into one of the largest he can lay hold of. The result of his treatment is tall weedy plants or total loss from sourness of soil and damp. The gradual transplantation from a small sized pot into a larger, is a very important matter, and should never be neglected when specimen plants are desired. The soil should be light and rich, and the pots thoroughly drained. I find the following to be a very suitable mixture of soil, viz., one part loam, one part old cow or stable manure, one part leaf mould and one part sharp river sand. Water liberally, but take care that the soil in the pots never becomes sour owing to defective drainage.

In order to save seeds from the Camellia and Carnation flowered varieties sent out to this country by European nurserymen, the sowings made from the beginning to the middle of July, should be specially looked after. Sowings made previous to that time generally fail to produce seed, owing to damp, and those made later fail owing to cold. When the plants are densely branched, thin out the lateral shoots, so as to allow of all those remaining to stand clear of each other. If the strain is a good one, the flowers will be very double, hence many may fail to produce seed, and those that do, only produce it in small quantities. As they seldom all fail to produce a few seed pods in October and November, a few ripe seeds are generally obtainable. These should be carefully stored, and kept until the following July, and sown between the beginning and middle of that month. The *flowers from the acclimatized seed of the first season are invariably* of poor quality. Many are single and semi-double, and a few double, but inferior to the flowers of the previous season, grown from imported seed. The best double flowering plants should be selected as seed bearing stock, and kept as far as possible from the plants with single and semi-double flowers. If selection and isolation is carefully attended to, it will be found that the proportion of good double flowers will increase yearly, and in the fourth season, out of hundreds of plants scarcely any single or semi-double flowers will be met with. The strain of acclimatized balsams you thus secure will seed freely, and possess flowers nearly of equal merit to those of the best imported varieties. They are also much hardier and not so subject to damp off during periods of excessive rainfall.

W. G.

A TREE YIELDING BALSAM OF COPAIBA IN THE GHAT FORESTS OF COORG.

This promises to be a valuable discovery. Its history is rather a curious one. Mr. A. L. Tod, who for some years has been resident in these forests, happened on a tree two or three years ago, which when cut into yielded an oily liquid, which gushed out copiously from fissures in the heart of the tree. He did not think much of it at the time, but a month or two ago, I shewed him a compilation of information all about rubbers, published by Messrs. A. M. and J. Ferguson of Colombo, the editors of that useful periodical "The Tropical Agriculturist." Amongst the various papers about rubbers collected in their little book is one by Mr. Cross relating his experiences whilst hunting up Ceara and Para rubbers, and also a short account of the Balsam of Copaiba tree. On reading this Mr. Tod said at once that his oil tree behaved exactly like the Copaiba tree

described by Mr. Cross. He did not know what the tree was like, nor where to look for it. Luckily, however, he was making a clearing for a teak plantation at Kootampolle at the bottom of the Perambadi Ghaut, so orders were given to the fellers to report any tree which spouted any liquid from its centre. It was not long before one was found, and some of the liquid collected. It was a thick oily substance of a claret red. On comparing it with the medicinal Balsam of Copaiba, I find the latter is not so thick and is a yellow colour, and also has a more pungent odour, though there is no doubt that our liquid has the characteristic smell in a less degree.

I have just returned from an expedition to Kootampolle, where Mr. Tod and I had a great search for the tree. The clearing had in the meanwhile been burnt, and the tree therein charred, so that we had little to go on, except the leaves which had been gathered from it, and on cutting into the trunk we saw the structure of the wood. We also noticed that it was not a buttressed tree. These two points were indeed all we had to go on for a long time, for in these heavy evergreen forests, it is very little that can be seen of the leaves of a tree unless of very peculiar shape. The first day we were quite unsuccessful. The second we began by searching this clearing, and soon found several stumps which had the liquid still standing in them, so it was evidently a fairly common tree. We then looked very carefully round the edge of the adjoining jungle, and at last found a tree. After that it was comparatively plain sailing as we soon caught the characteristics of the bark and habit of trunk, which is pretty nearly all that one has to go on in these forests.

Unfortunately the tree has neither flower nor fruit at this time of year. But Mr. Tod is going to have one felled every now and then until he can get the flower. The leaves are somewhat like the *Pterocarpus marsupium*, but very irregular in size, varying from 2 to 5 inches, also in shape, being sometimes lanceolate sometimes ovate. I enclose a few specimens.

I am sending the liquid home to be reported on. From the second tree we operated upon, we obtained two different liquids. The one the thick oily stuff already described, and the other a yellow watery fluid with a very disagreeable smell. I thought at the time, that this would turn out to be the true balsam of copaiba, and so sent off some of it to England, as well as the oily fluid. But on further examination I fear it is useless.

I will send the London report on the liquid to the "Forester" as soon as I receive it.

F. B. D.

Fig. 1.

Fautrat in France, 1877.

Height 45'·9	Temperature comparatively + 0°·2	Temperature comparatively + 0°·2
	Inside the forest	Outside
4·6	− 1°·1	0°·0
		(really 50·7°)

Fig. 2.

Ebermayer in Germany, 1872.

Height 40·0	Temperature comparatively − 0°·7	Temperature comparatively ?
	Inside the forest	Outside
4·7	− 1°·8	0°·0
		(really 49·6°)

Fig. 3.

Comparative Table of Minima and Maxima with the outer air at 4·6 as standard.

	Height	Forest		Outside	
	Feet	Min.	Max.	Min.	Max.
Fautrat in France, 1877.	45·9	+ 1·4	− 0·7	+ 1·8	− 1·1
	4·6	+ 0·2	− 1·8	0·0	0·0
				(really 41·0	60·0)
Ebermayer in Germany, 1872.	4·7	+ 2·7	− 3·5	0·0	0·0
				(really 40·1	59·0)

Fig. 4.

		Ozone inside.	Outside the forest.
Fautrat France	45·9 feet	8·6	8·6
	4·6 feet	9·0	8·4
Ebermayer, Germany	40 feet	7·9	?
	4·7 feet	7·8	8·1

RESULTS OF FOREST METEOROLOGY AS HITHERTO PUBLISHED BY EBERMAYER IN GERMANY AND FAUTRAT IN FRANCE.*

IN order to find what effects forests have upon the atmosphere and climate of a country, the first step is to ascertain the actual conditions of the air inside and outside the forest.

Ebermayer's work, published in 1873, shows that 4·7 feet above the ground, the air inside good forests in Bavaria is 1°·8 cooler than the air outside. In the crowns of the trees, which we may take as 40 feet high, the air is 0°·7 cooler than the air outside at 4·7 feet from the ground. Fautrat, in experiments which succeeded those of Ebermayer, went further by ascertaining the temperature of the air outside of the forest also at a greater height. He observed at four places, namely 4·6 feet above the ground inside and outside of the forest, and at 45·9 feet above the ground inside and outside. Taking again the lower observatory outside the forest as the standard of comparison, his results are shown by the following statement, *vide Fig.* 1.

I subjoin a statement of similar form with Ebermayer's results, *vide Fig.* 2.

Fautrat obtained his figures as the means of daily minima and maxima, Ebermayer as the means of 8 A.M. and 5 P.M. observations. Neither figures are therefore true means, and it must be remembered that the true means might give quite different comparative results. For instance, Ebermayer's figure − 1°·8 near the ground inside of the forest changes into − 0°·4 when the means are calculated from Ebermayer's daily minima and maxima.

Until true means have been ascertained, we can only give the general results of observations in Central Europe as follows. The mean between daily maxima and minima is in the forest 4·6 feet above the ground, about 1° Fahrenheit less than in the same height on a meadow outside. At 46 feet from the ground, just above the crowns of the trees, the air of the forest and of the land outside is of the same temperature, and a trifle (0°·2F.) higher than 4·6 feet above the ground outside.

Small as the differences of temperature are, it must be borne in mind that very considerable effects may take place, accompanied by comparatively insignificant changes of temperature in the air, which interchanges so easily. In India the differences of temperature will be very much greater than in Central Europe.

The diagram (*Fig.* 3) shows what influence the elevation above the ground and the forest had upon daily minimum and maximum temperatures.

---

* All measures in English inches and feet, and all temperatures in degrees Fahrenheit.

Taking the temperatures 4·6 feet above the ground outside of the *forest as standard, we find in all the other positions the minima* higher and the maxima lower. The differences are not equal, but they average about 1 degree in the French experiments and 3 degrees in Germany.

Ebermayer determined the vapor tension inside the forest and outside at a height of 4·7 feet. He found it 0·31 inch inside and 0·30 inch outside. These figures differ so little, that we may say the tensions are practically the same. If therefore Ebermayer found the relative humidity more in the forest than outside, the difference must almost entirely be accounted for by the lower temperature inside of the forest. His figures are 85% inside 78% outside.

Fautrat has for deciduous forest at the height of the crowns *(45·9 feet) 73% and 70% respectively. For pine forest he has* following percentages :—

		Relative humidity.	
		Inside.	*Outside.*
39·4 feet height,	...	68%	61%
4·6 feet height,	...	74%	60%

Taking all the above data together, we may conclude that near the ground the vapor tension inside and outside the forest were practically the same, that the relative humidity near the ground was in the forest about 70%, at the height of the crowns over the forest 75%, near the ground outside 65%, and at the height of the crowns outside of the forest also 65%. These are, however, merely approximate figures, sufficient to give a general idea of what differences prevail. The real determination of the mean relative humidity, taking in all hours of day and night, cannot be said to have been made in these cases, and the results might be different if the real means were ready for comparison. (Whilst Fautrat found the outer air comparatively richer in vapor higher up, the experiments at Dehra Dun in 1883, show the air at 66 feet to have about 5% less relative humidity than at 4 feet from the ground).

Assuming it to be proved that the air in the forests is relatively moister, it depends now how much interchange takes place between the air in the forests and the outer atmosphere. Before however this can be traced, a further examination is of the utmost value, to determine the temperature and the moisture of the air above the forest and above the outer land at a height about double that of the forest trees. This has apparently not yet been done in Europe, and it would give very important results in India, where all the effects of the forests must be greatly intensified, owing to the hot climate and the great changes in the state of moisture during different seasons of the year.

As regards the rainfall, Ebermayer made no comparative experiments between the *forests* and the *outside, but he believes*

that in uniform plains the influence of the forest upon the quantity of rain is very small. It increases with the elevation above the sea, and in summer.

Fautrat set up rain gauges over the forest and at the same heights above the ground outside. Taking deciduous and pine forest together, he obtained 35·1 inches of rain over the forest, and 33·3 inches of rain over the outer land in a year. This means a difference of 5 per cent. in favor of the forest.

In view of this result I must, however, refer to the undoubted fact that especially in cold weather the more elevated rain gauges receive less rain than those nearer to the surface, so much so that in one case the rain collected at a higher elevation was only one-half of that collected near the ground. If we consider the upper limit of the forest as a second surface, and apply the above rule to it, the rainfall on this surface (formed by the crowns of the trees) should equal that near the ground outside. The rainfall on the raised platform over the outer land should be less than near the ground outside. Hence naturally the rainfall on the high platform outside will be less than amongst the crowns of the trees, and this fact might thus prove nothing at all in favor of the forest. This applies also to Mons. Fautrat's results. The matter should be further enquired into by having also rain gauges near the ground outside, and also at a height double that of the trees over the forest as well as outside.

Fautrat placed also rain gauges on the ground inside of the forest. The comparison between the results with rain gauges near the ground and with rain gauges above the crowns of the trees shows how much rain was intercepted by the foliage. Fautrat found the interception equal to 40 per cent. of the rainfall which reached the upper surface of the forest.

Ebermayer's figure obtained from seven stations is 26 per cent. Fautrat had only two stations. Giving in the case of each author credit for the number of stations, we arrive at the round average figure of 30 per cent. as the interception of rain caused by the foliage of fully stocked forests (pine and deciduous) in Central Europe.

Ebermayer and Fautrat have both made experiments regarding the quantity of ozone in the air of forests. There is not much difference in the proportion of ozone at different heights and inside and outside of the forests. The results deserve attention on account of the remarkable agreement between the ozone and the mean temperatures as given by each of the authors. *Fig.* 4. There is least ozone near the ground inside of the forest.

Ebermayer made a series of other observations, of which the most striking results are given in the following.

He determined the temperature of the soil at various depths from the surface to 3·7 feet, inside of the forest and on the stations in the *meadows* outside.

	Inside of the forest.	Outside of the forest.
Mean temperature of the soil at 3·7 feet depth, ...	18°·2	25°·0
Difference, ...	6°·8	

The soil at 3 7 feet depth is thus on the mean of a whole year 6°·8 cooler than outside.

The temperature inside of the standing trees was observed, and from two daily readings averages were calculated for the whole year.

Height above the ground.	Temperature in the forest; of the trees.	of the air.
About 40 feet in the crown of the trees, ...	47·8	48·9
About 4 7 feet, ...	45·7	47 8

In the crown the trees are 1°·1 cooler than the air, near the base (4·7 feet) the trees are 2°·1 cooler than the forest air surrounding them.

Another experiment of Ebermayer was, that he set up small vessels with 1 square foot open surface, inside and outside of the forest. He sheltered the vessels from sun and rain, and left free access to the wind. He filled the vessels with water, then with *moistened earth, then with moistened earth covered* in the forest by leaf mould.

The evaporation of water in these vessels when water or moistened earth was used, was in the forest only 37 per cent. of what it was outside.

When the vessel with moist earth in the forest was covered with leaf mould, the evaporation was only 16 per cent of that which took place during the same years outside the forest, in a vessel not covered with leaf mould, but otherwise treated in the same way.

The above facts must be well understood, otherwise they will mislead. They are not meant to indicate the amount of evaporation which really goes on under usual circumstances in a forest and on the land outside.

We find that the air inside of the forest is in a state which favors evaporation much less than the air outside, but the forest soil retains water and keeps up evaporation at times when the evaporation outside is almost nil for want of water in the soil. Further there is all the evaporation in the foliage of the trees to be placed against the evaporation in low grass on the meadows. *The lower temperature of the air in the forest,* the greater degree of moisture, and the diminution of the winds, are three causes bringing about the small amount of evaporation from vessels with water or wet soil exposed to the forest air. The ac-

tual evaporation in the forest the whole year round must, however, be so much greater than in the grass land outside, as the total proportion of rain water which flows off over ground and under ground is less in the forest than on the grass land outside.

H. WARTH.

A MANUAL OF INDIAN TIMBERS.

By J. S. Gamble, M.A., F.L.S.

We are ashamed to say how long a copy of this excellent work has been daily staring us in the face, but no one knows better than the author himself that the Indian Forester is not often overburdened with that always much-coveted, hourly-sighed-for commodity—leisure. To review this book adequately would require several long consecutive notices and many entire days passed among the several thousand specimens forming the unique collection of woods at the Forest School. We had vainly hoped to have been able to make for ourselves this leisure, but *kismat* has been too strong for us hitherto, and rather than delay any longer, we will at once attempt to give some idea of the book to those of our readers, who are so unfortunate as still to be without a copy of it.

The idea of writing such a work arose during the preparation of wood specimens for the great Paris Exhibition of 1878. Such a large number of specimens of undoubted botanical determination was collected, that the opportunity was seized of supplying a "good stock to the Royal Gardens at Kew and to other museums both in Europe and America;" as well as type collections, for reference and study by Indian Forest Officers, to the various Conservators' offices in this country The next and almost simultaneous step was to prepare a work embodying a correct description of the structure, properties and uses of these various woods.

Every circumstance was favorable for the preparation of such a book. The number of species represented in the collections was large, and included very nearly all the more important ligneous plants growing within the territories ruled over by the Viceroy of India. Moreover, nearly every species was represented by several specimens grown in various portions of those territories under various conditions of soil, climate and locality. A well organized workshop was at hand, superintended directly by Mr. Gamble, assisted by Mr. Smythies, and during part of the time, also, by Dr. Warth, both of whom were specially deputed to aid Mr. Gamble. And last but not least, Dr. Brandis, the Father of Indian Forestry, was there present with his great knowledge and vast experience to start the work and direct its progress.

The chief points of information recorded under each species are, to use, as nearly as possible, the author's own words—

1. The scientific name, with synonyms.
2. Selected vernacular names.

3. Description of the wood.
4. Geographical distribution, briefly.
5. Record of all available information regarding rate of growth.
6. *Results of all experiments on weight and strength* that it was possible to quote.
7. General uses of the wood and of other products of the tree.
8. List of specimens used in identification and description.

Besides this, "some attempt has been made to notice even the species which have not been described. In some important genera, a list of known species and their geographical habitat has been given, in other genera other species of note have been mentioned, and, whenever possible, notes regarding the uses and qualities of the wood and the other products of the trees so referred to have been added. One great object in having thus mentioned other species has been kept in view, *viz.*, to show Forest Officers and others who may have the opportunity, *what we have not got*, and so persuade them to help, by sending to the writer or to the Forest School Museum, specimens that can be described, and help at some future time in the publication of a more correct and complete description of the Indian woods than can now be attempted."

We hope all Forest Officers will heartily respond to this invitation. But the enumeration of those additional species also serves another purpose. For instance, once, when we left our Kew Flora in the plains, we identified, with the aid only of the "Manual of Indian Timbers," *Leucomeris spectabilis* (called in Kumaon *Kapíshi* not *Panwa*, in Garhwal *Pándu*), *Hypericum cernuum*, and many other shrubs, complete strangers in those days, but our every-day friends since. The lists of such plants have been compiled with great care and judgment, and will probably not be found to omit any described Indian tree or shrub of any note.

The vernacular names given are fairly exhaustive, considering the great difficulty, that at present exists, of getting well authenticated local names. This comes of course from all Forest Officers not being systematic botanists; but now that the Department is sufficiently well organised, there ought to be no difficulty in establishing in each Forest Divisional office a well-arranged herbarium containing complete specimens of every tree and shrub, and also of very characteristic herbs growing within the Division in question. The Superintendents of our various *Botanical Gardens and botanical Forest Officers would no doubt* be very glad to name the specimens. In this way complete local lists of vernacular names could be prepared, and a general one for the whole of India would then simply be work for a compiler.

The plan just sketched would also ensure accuracy in defining the habitats of plants. At present few know that *Prosopis spicigera* is found in Nimar in the Central Provinces, and that *Buchanania angustifolia* comes up as far north as Chanda in the same provinces.

The most important, as it is the truly original, portion of the Manual is the description of the wood and bark of the trees and shrubs noticed. These descriptions were usually dictated by Dr. Brandis, after full discussion with Messrs. Gamble and Smythies. The generic and family characters were not discussed and established until constant practice had given facility in seizing at once essential differences of structure. For the descriptions of the later received wood specimens, as well as of those given in the *addenda*, Mr. Gamble alone is responsible, although he adhered throughout to the original plan adopted.

The main object of these descriptions is confessedly to enable the reader to identify by their means the species of any wood of which he is ignorant; but Mr. Gamble very rightly warns him, "that there is no regular rule for determining orders and genera by means of the wood, for in some cases the structure of the different component genera or species presents characters of a very dissimilar type." But the same absence of a *regular rule* as regards the structure of flowers and fruit is the great stumbling-block over which 99 out of 100 students of systematic botany come to grief. Would it be then rash to suggest that we have perhaps not yet hit on the right method of examination and description of wood structure, and that we are still in what may be called the Linnæan stage of our subject? And may it not be that the systems of classification now adopted by botanists will at some future time have to be modified by their successors being compelled to admit among essential characters differences of structure of the wood?

But without making any heretical suggestions, we more than *hope* that, "with a rather wider acquaintance with the woods of India, we may be in a position to draw up an analytical table for the woods which are most chiefly in use in India, similar to that given at the end of the French Forest Flora." And we hope that Mr. Gamble himself will forge for us this analytical key.

We wish we could deal fully with the descriptions of the various woods noticed, but, as said before, time is our tyrant. We can only say that the descriptions are clear and pithy. Under most of the natural orders the determination of genus and species follows easily, although our own eye would not unfrequently assign different shades and tints and occasionally even colours to some of the specimens described. For instance, we would not term the wood of *Anogeissus latifolia* grey. But on the subject of tints and shades *quot homines tot sententiæ*.

In a few cases, owing to imperfect specimens being examined, some serious errors occur. Thus the wood of *Boswellia thurifera* is described as "rough, white when fresh-cut, darkening on exposure, moderately hard." The existence of a dark greenish-brown, often mottled heartwood is ignored. This heartwood, far from being *rough*, can be planed almost as smooth as teak. The mistakes made in Brandis' Flora, and which were clearly pointed out in an article, signed THE POOR SALAI, that appeared in the "Indian Forester" of April 1881, are repeated in November 1881. Again, the wood of *Bauhinia Vahlii* is described as consisting of "irregularly-broken concentric layers." Really the wood consists of rope-like masses of wood *(Sachs' Xylem)* embedded in a red bark-like substance (*Phloem*). In other words, the stem consists of *closed* fibro-vascular bundles, which for the first year or two are necessarily arranged in a concentric manner round the cross-shaped pith, but lose all concentric disposition afterwards, as new bundles form near the circumference in the most irregular manner.

The case of the *Bauhinia* reminds us of a much felt desideratum in the Manual, *viz.*, a Chapter on the Formation and Growth of Wood. Such a Chapter would have contributed very considerably towards a true comprehension of the rest of the book, the interest of which it would have appreciably increased—a Chapter embodying, in a more readable form than the heavy originals, the discoveries of German vegetable physiologists, and written with special reference to Indian trees and Indian conditions of climate and soil. Such a Chapter, it is to be hoped, will now be supplied by the Manual of Indian Sylviculture in course of preparation at the Dehra Forest School.

Through the omission of this Chapter has crept in the error of employing the terms "concentric rings" and "annual rings" as exact synonyms. "Annual rings" is the title of the fifth of the eight general heads under which each species of wood is described. Under the blind thrown by this misnamed head the eight distinct concentric rings in the specimen of teak pole from the Andamans numbered B 1346, and aged only 4 years, escaped notice.

But these are mere trivial deficiencies in comparison with the unquestionably great value of the book, and must occur in every first essay in a new *genre*. The wonder is they are so few and insignificant. Having such a volume already as a guide, the preparation of smaller, but on each individual subject fuller, works of local scope, or of a new and improved edition of the original book, will be a comparatively easy matter. In these editions short studies of the destructive insects, to the attacks of which each species of wood is liable, should, if possible, be given.

No Indian Forester, Engineer, Planter, Agriculturist or Merchant should be without a copy of this Manual of Indian Timbers. We are proud that the Indian Forest Department has within it the brains and industry to produce such work. To Dr. Brandis (who will never cease to have claim to the gratitude of Indian Foresters), to Mr. Smythies, and last, but not least, to Mr. Gamble, who has to his sole count written half the book, and edited with conspicuous success the whole of it, we owe a world of thanks. In the words of the old Roman Commonwealth, *Bene meruêre de re publicâ.*

NOTE ON A RECENT CASE REGARDING DRIFT TIMBER.

TO THE EDITOR OF THE "INDIAN FORESTER."

SIR,—I would ask, are not the Government sleepers in the Punjab stamped or marked in any way? It strikes me that if the sleepers found in the house of Rádá Kishn had had say "J. 11-'82" on them, indicating that they were "November '82 sleepers of the Jhelam Division," the case need not have so exercised three tribunals.

SIMPLE SIMON.

III. Notes, Queries and Extracts.

A WONDERFUL TIMBER REGION.

Very far west indeed, in a lovely country which once belonged to England, but which was ceded to the United States in 1846, there grows the finest body of timber in the world. Fir and pine, and oak and cedar, of unsurpassed quality, and practically unlimited in quantity, clothe the mountains, overhang the rivers, and shadow the plains of the Puget Sound district, in Washington Territory. On a moderate estimate it is calculated that this region will yield the enormous and unimaginable quantity of 160,000,000,000 feet of valuable timber. The trees attain a remarkable development, both of height and beauty. The yellow fir is frequently found growing to a height of 250 feet; the white cedar to 100 feet with a girth of over 60 feet; and the white oak to 70 feet; whilst ordinary sized specimens of the sugar pine yield from 6,000 to 8,000 feet of lumber each. For long after its discovery this marvellous store of timber remained undisturbed, its primæval quietness unbroken by the sound of the woodman's axe. But in 1851 a saw-mill was built on Puget Sound, and thenceforward continually increasing inroads were made upon the forest, until to-day no less than fifteen such mills are at work upon it. The largest of these has a cutting capacity of 200,000 feet per diem. During the year 1881 the export of lumber from Puget Sound amounted to 174,176,700 feet, valued at nearly 2,000,000 dollars, and it is calculated that since the establishment of the first saw-mill about 2,500,000,000 feet have been cut. Yet in spite of this great tax upon them we are told that the forest remains, for the most part, in virgin condition, except for a short distance from the banks of the streams and estuaries. It is, of course, too late for regrets, but one cannot help reflecting that the loss of this magnificent region was indeed a serious one for the British Empire.—*Colonies and India.*

THE
INDIAN FORESTER.

Vol. IX.] July, 1883. [No. 7.

TRANSLATION OF M. PUTON'S AMÉNAGEMENT DES FORÊTS.

B.—*Conversion of Coppice wood into High Forest.*

General considerations.—I have explained in the first chapter, the reasons which make it the duty of the State to become the owner of high-forest, and to convert into such forest the greater part of the forest which it owns, and which may happen to be under the coppice *régime*. These reasons may to a certain extent be applied to the case of Communities owning forest estates, since they are small societies (having a perpetual legal existence), and in the vicinity of their estates, the Government may possess no forest, although there is a great local demand for timber of large dimensions.

It is often asked, why should the forest belonging to a Commune be treated differently to that of a private owner?

Why is it that measures which are wise and good in the case of private property are not so when a Commune is owner?

The reply is easy. High forest brings in much more in volume of material, than coppice, but the rate of interest on the capital engaged in a coppice management is much higher than that which is yielded by the capital in the case of high forest. Now in the French Communes there are in reality two classes which have a right to the produce of the woods; the inhabitants as individuals, and the joint body as a legal person. The inhabitants do not care how the capital is invested: what they want is the greatest possible annual production; and high forest management alone tends to this result. The body also is merely the trustee of the forest capital, it cannot do with it as it pleases, it must transmit it, intact, to future generations, it is then not concerned with the fact that the capital is small or great, that it is invested at a high rate or a low; what it really cares for, is, that the annual yield should be as great in volume as possible, because this means a correspondingly large annual income, of which the body will have the disposal. It may

well be then, that the Commune is benefitted by having forest capable of yielding timber, which private forests cannot yield, and which there are no State forests, sufficiently near at hand, to supply profitably.

If *then a Commune possesses* forest of which the capital is constituted, or is pretty nearly constituted for high forest working, it will be certainly best for it to adopt that *régime*. The inhabitants will gain most, so will the Municipal treasure-chest, and so will the different industries in the locality. If, however, the requisite forest-capital is not already constituted, then it may be a serious question whether it will be wise to attempt to undertake the conversion of what does exist, into a capital fit for high forest working. Such a step will generally only be possible, when the Commune is rich, when the forest consists of species which do not coppice well, and when the forest is of sufficient extent to make it worth while to undertake the various operations which are necessary in attempting the conversion. It is easy to imagine, that whatever may be the methods employed, the result must be a present diminution of production; for the change is from a stock aged from 1 to 30 years, to one aged from 1 to 120 years: such a change is impossible without occupying a long time, and diminishing to some extent the immediate yield. It is true that the work can be carried out by the formation of a series of reserves in the coppice compartments, so that we do not all at once diminish the yield of the first years, while as the increase in growth is considerable in the trees reserved for timber, this tends to compensate by augmented value, for the loss in quantity. The methods of "conversion" in the case of simple coppice, are practically the same as in the case of stored-coppice, which I will first attempt to explain. But I must draw a distinction between stored coppice which has always been worked regularly, and that which has an irregular stock resulting from various methods of working.

§ 1.—*Conversion of regularly stocked Stored-coppice.*

In forests of this class, the capital is in its nature double: we have the coppice material spread over the entire area, in one graduated scale of ages, say from 1 to 30 years; we have also the standard trees forming a complete series on *each coupe* according to another scale which is determined by the plan of reservation of stores. In order to constitute a single capital on a scale from 1 to 120 years over the whole forest, neither of the existing forms of capital suiting us, we can realize the one or the other, and utilize it gradually during the period occupied by the conversion. That is the basis of the different methods usually employed; we are engaged in consolidating a capital on a scale of from 1 to 120 years; during the time so occupied, we use up the existing material, which may be that of the standard trees,

or more frequently is a combination of these and some of the old coppice. The unavoidable diminution of the amount of produce which we have to submit to, will be much lessened by the working out of the reserves of the old coppice, or by a combination of the elements of the former system. It may even happen that if the standard trees are numerous, there will really be very little diminution during the conversion-period : that will, however, depend on circumstances and on the method employed. The art of the *aménagiste* (framer of the working-scheme) will be shown, in making the burden as little felt as possible, by spreading it over a number of years.

In order to create a capital in a scale of ages from 1 to 120 years, it is necessary doubtless to have 120 years of time! But if we have already wood ranging in age from 1 to 30 years, we can at once diminish the *formidable period ; hence arise two methods*, which by their combination give rise to *a third*.

I. *The method of preparatory fellings*, under which the capital is formed by aid of the stems already on the ground, in the hope of reducing the length of the period of conversion.*

II. *The method of temporary coppice*, under which the capital is not formed out of any existing stems, but by creating a seedling growth to form anew the required scale of ages, and necessarily occupying a period of time equal to the rotation of the high forest.

III. *The mixed method*, which consists partly of one, partly of the other, prepares the growing stock so as to provide for a seed shedding and springing up of a natural forest from seed, and completes the organization of the whole, by keeping up the coppice-working for a time at certain points.

The third method is naturally the most followed in France, because it suits best the circumstances of vegetation, and it is most easily adapted to the peculiarities often exhibited by irregular forests, of which we shall speak when we have first described each method separately.

It would perhaps be unnecessary in an elementary book to describe the first and second methods at all, were it not that a knowledge of them is necessary to compare results and to bring into prominence the advantages of the third.

In our explanation we will assume a forest of 600 acres which has been hitherto under coppice cut at 30 years, and which we desire to convert into high forest exploitable at 120 years.

I.—*Method of Preparatory Fellings.*

The whole plan is based on the idea of letting certain coppice

* The Author had previously called this the "direct method," but he rejected this term as it was not really distinctive; for the second method is also *direct*, as it consists in getting up the same forest again, not indeed from the stools, but by means of natural or artificial seedlings.

stems grow old, contenting oneself, the while, with the produce of cleanings, thinnings, and the extraction here and there of old and middle aged standards: by letting the forest grow for 20 or 30 years, for example, we shall get trees aged from 20 to 50 or from 30 to 60 years: then the working is arranged for, by one of the methods already explained for forests of which the capital is not yet constituted.

The duration of this period of waiting is difficult to determine exactly; if it is kept on too long, we shall get material older than we want. Experience alone must be our guide in this matter; all that we can say is, that the period must be long enough to allow scope for a working scheme with a high forest period of rotation according to one of the methods indicated (page 275). Generally we are content to make this transitory period equal to one coppice rotation, *i. e.*, 30 years, according to the example we have chosen.

The framework of this plan of working is at once laid out on the ground itself, and according to it the different portions of the growing stock will be prepared and modified. For example, we shall establish four periodic blocks of 150 acres each, with the intention that one day these shall correspond to four periods each of 30 years. We have in fact a working scheme, the application of which is suspended during a period of transition.

During this period, we carry over the whole forest, certain cuttings which are preparatory for high forest, or as we may call them, "conversion-thinnings." In this process, we remove the shoots that are dominated or suppressed, cut such trees as are fit for removal, and arrange so that selected stems from the coppice growth be retained to fit in with the requirements of high forest growth. In this way we shall gradually get the stock regular as a whole, if not in individual portions of the forest.

Such conversion thinnings are made by area, and may twice pass over the entire area of the forest during the period of transition; consequently each will extend to $\frac{1}{15}$ of the whole area at a time.

The character of the work to be done is determined by the number (in the series or working-circle) of the periodic block in which it is being carried on; that is to say, in the earlier affectations it is the old trees that we take in hand, so as to favor regeneration; in the later blocks it is the youngest trees, and in the middle of the series it is trees of middle age.

On the completion of the transitory period we begin with the actual periods of the permanent working scheme, regenerating first the periodic block No. I, then No. II, and so on. But it is necessary to remark, that as a whole the forest will, under this method, chiefly consist of stems which have grown up as shoots from the stump: such are without any very solid hold on the soil and without any favorable future prospect; it will often be advisable, in view of ultimately having a real working at an age

of 120 years in four periods of 30 years each, to shorten the first rotation, for example to one of 80 years in four periods of 20 each. Then the principal object which we had in view under the method we are considering, namely, to make use of the materials already existing, is poorly attained, since after a first period of waiting extending over 30 years, and a transitory rotation of 80 years, we shall have spent 110 years in completing the transformation. Moreover, in thus making up our growing stock with coppice stems mixed with existing standards, we shall get a forest in which groups of trees are found ill composed, not homogeneous, which are only regular in appearance, and whose chances of long life are not well assured. It is only in coppice forests in mountain countries consisting of beech and oak, and free from soft woods, (as poplars, willow, &c.,) that this method, formerly much in vogue, has a chance of giving first rate results.

It is nevertheless important to understand how the cuttings are made under this method, because the same treatment has been made use of under a more perfect method. The thinnings of coppice with the object of conversion prepare the soil for natural reproduction by seed, better than anything else; the too dense cover is removed, and the stool shoots are cleared off, which would otherwise be a serious obstacle to the growth of natural seedlings. This style of cutting also greatly helps the formation of a good vegetable surface soil.

II.—*The method of temporary Coppice.*

The essential feature of this method is, that it does not count on any of the existing growth to constitute the capital of the future high forest; on the contrary, the whole of the existing growth is entirely used up in furnishing a yield during the period of conversion.

The scale of ages from 1 to 120 years will gradually create itself as the work progresses, and the period of conversion will necessarily be equal to the period of rotation for our future forest, which by hypothesis is here 120 years. The period is called the transformation-rotation *(révolution de conversion.)*

The first step will be to divide the forest into periodic blocks, so as to have the general framework on which to model the growing stock to be created. When a high forest is constituted, the blocks must fulfil a necessary condition, that is, they must correspond to periods of regeneration, that is to the term of years necessary (according to the climate and the kind of tree) for the complete regeneration of each. In the present instance, the blocks adopted must not only satisfy this condition, because they represent the permanent framework of our future plan, but also they must satisfy another condition, which is that they must correspond to a coppice-rotation, since, while one block is undergoing regeneration the working for coppice will continue

on the others. Each block except the one in hand at the time, forms a coppice-series for temporary purposes, in which the coppice method of cutting will last for a greater or less time according to the number in the serial order of periodic blocks.

To make it easier to explain this method, we will suppose that our 600 acres have been worked in four coppice series of 150 acres, with a rotation of 30 years. We shall then start with a working scheme of four periodic blocks corresponding to periods of 30 years, and formed each of a coppice-series thus:—

I.	150 acres,	... ...	1—30 years.
II.	150 „	... ...	1—30 „
III.	150 „	... ...	1—30 „
IV.	150 „	... ...	1—30 „
	600 acres.		

The plan of exploitation will be as follows:—

First Period (1880-1909).

Ist Block. Regeneration by shelter fellings (*vide* p. 279) over 1-15th of the area yearly, returning again to make further cuttings to free the young seedling trees, by cuttings which will be by area, or by volume.

IInd	Block.	Coppice fellings at 30 years, 5 acres annually.
IIIrd	„	„ „ „ „
IVth	„	„ „ „ „

Second Period (1910-1939).

Ist	Block.	Cleanings though the young wood from 1 to 30 years.
IInd	„	Regeneration by shelter fellings.
IIIrd	„	Coppice fellings at 30 years.
IVth	„	„ „ „

Third Period (1940-1969).

Ist	Block.	Thinnings though the wood from 30 to 60 years' old.
IInd	„	Cleanings though the wood 1 to 30 years' old.
IIIrd	„	Regeneration by shelter fellings.
IVth	„	Coppice fellings at 30 years.

Fourth Period (1970-1999).

Ist	Block.	Thinnings in wood aged	60—90 years.
IInd	„	„ „	30—60 „
IIIrd	„	Cleanings, „	1—30 „
IVth	„	Regeneration by shelter fellings.	

In this method the coppice fellings gradually diminish in extent and importance, in proportion as the high forest is produced and comes on to maturity. The amount of material at disposal may not suffer any serious reduction. Indeed, possibly during the first period it will be increased, because the entire coppice stock is given up to working.

It is only in the second period that the diminution will be felt, because the cuttings in the first periodic blocks will then only be cleanings of small value, but it can be arranged during the first period so to increase the number of stores in the areas still worked as coppice, as not only to allow a better chance of seed shedding, but to supplement the poor yield of the second period. The equalization will be at least in *value*, if not in *volume*. As it is no advantage to create a temporary 'series' for coppice in each periodic block, it will increase the chances of success for shelter fellings in the periodic block under treatment, (in which seedlings are always in danger from stool-shoots,) if we modify the old series of coppice in such a manner, as to group together in the first periodic block, the old coppice stems, which are more fit for cutting. The periodic blocks in which coppice fellings have to continue will thus temporarily be united into one consecutive group of fellings, the importance of which diminishes at each period, in which also the shelter fellings are first undertaken in the oldest coppice.

If the forest has been worked in a *single* series for coppice at 30 years, taking 20 acres a year, the formation of these periodic blocks is perfectly natural and easy.

I.	150 acres,	... ...	coppice of	24—30 years.
II.	150 ,,	... ...	,,	16—23 ,,
III.	150 ,,	... ...	,,	8—15 ,,
IV.	150 ,,	... ...	,,	1—7 ,,
	600			

If on the contrary the coppice forest has been hitherto worked in more than one series, then we must try to group the ages so as to form a first periodic block, in which the oldest coppice shall come first, and then a succession of fellings with a reasonable difference of age so as to form a coppice cutting in a single series.

The plan of felling as a whole will then present something like this—

First Period (1880-1909).

I.	150 acres,	24—30 years.	Shelter fellings (at 1-10th area): 15 acres.
II. III. IV.	450 ,,	1—24 ,,	Coppice (at 1-30th of area): 15 acres.

Second Period (1910-1939).

I.	150 acres,	1—30 years.	Cleanings.
II.	150 ,,	20—30 ,,	Shelter fellings (at 1-10th area): 15 acres.
III. IV.	300 ,,	1—20 ,,	Coppice (at 1-30th of area): 15 acres.

Third Period (1940-1969).

I.	150 acres,	30—60 years.	Thinnings.
II.	150 „	1—30 „	Cleanings.
III.	150 „	15—30 „	Shelter fellings (at 1-15th area): 10 acres.
IV.	150 „	1—15 „	Shelter fellings (at 1-30th area): 5 acres.

Fourth Period (1970-1999).

I.	150 acres,	60—90 years.	Thinnings.
II.	150 „	30—60 „	Thinnings.
III.	150 „	1—30 „	Cleanings.
IV.	150 „	1—30 „	Shelter fellings (at 1-30th area): 5 acres.

Between these two methods of applying the same principle of management, it is the second which reduces the inconvenience necessarily resulting from the procedure of conversion to a minimum.

The inconvenience is, that the stools of the trees are perpetually sending out shoots which tend to suppress the young seedlings, and if the stores dispersed through the forest are not sufficiently numerous to suppress the clusters of stool-shoots, it will always be necessary to devote considerable care to the shelter fellings,* and this will involve some expense.

III.—*Mixed Method.*

In working by the method just described, we had the advantage of being able to introduce into the forest the species which are most suited to high forest, oaks for example, and conifers, and to build up a regular and homogeneous forest growth; but this method has some corresponding disadvantages, namely :—

(1). It is costly; the young growing stock is provided during each period, and throughout each periodic block, for the most part by artificial plantations, and the young seedlings have always to be defended against suppression by the shoots from the old coppice stools.

(2). The precise date of the period when the forest will temporarily be only able to yield a considerably diminished yearly produce (which the reader will remember, does not occur all at once) is left to the future and is unknown; and as it is impossible to say what may be the pressing requirements of that time

* We agree with M. Sée, in his remark (Revue forestière 1867, page 263) that in order to secure the older coppice for shelter fellings, we must commence cutting at the age of 24 or even 15 years, in the area where the coppice system is temporarily retained, and this will cause a difficulty in selecting suitable stores during the earlier years of the coppice rotation.

when it comes, it is possible that the completion of the conversion may be endangered.

(3). The coppicing has to be continued for one, two, and three, or even four periods: it may well be that in bad coppices, the land may become exhausted, and the coppice system no longer applicable. There is no such thing in science as the absolute application of any rule under all possible conditions; and it is so especially in forestry: the first method, notwithstanding the drawbacks which belong to it, does admirably for beech coppice, and for other forest in special circumstances: the second method is suitable, when we have to deal with simple—or stored—coppices, in which there are a variety of species including soft and inferior woods unsuited to form the material of a high forest growth.

The difficulties which beset both the one method and the other, have led foresters to adopt a method intermediate between the two, which borrows the preparatory fellings from the first, and the definite location of the operations, together with the shelter fellings, from the second. In consequence it is a method most generally applicable, seeing how numerous and variable are the conditions of the forests with which we have to deal.

Let us again revert to our old example, and suppose that we wish to keep our coppice at 30 years, so as not to repeat our fellings in so short a rotation that the good species would be endangered and worthless woods encouraged. We shall then arrange (as before) the locale of our operations on the ground, grouping them into periodic blocks corresponding to periods of 30 years.

The mixed method of treatment then will consist in making simultaneously with the shelter fellings, undertaken in the periodic block in hand, preparatory fellings in the block next to follow, and coppice fellings in the others.

The coppice system is abandoned in each period on one block, no longer for the purpose of natural regeneration, but to prepare its *growing* stock to furnish in the next following period the means of a good natural regeneration which do not at the moment exist, and to diminish the expenditure on artificial planting. The stores mixed with the old coppice will be preserved in making the preparatory cuttings, and they will furnish an important aid to the subsequent regeneration; but as leaving these standing will considerably diminish the amount of produce, we must try and compensate for this in some other way. With this object the coppice-series, which immediately precedes the series in which preparatory fellings are to follow, and which is only to remain during one revolution, will be so worked as to cut out chiefly the old stores, taking care to preserve the middle aged and young ones, and that in very considerable numbers, so that in the following period, there may be the best results obtained from the regeneration fellings.

The plan of working will then be as follows:—

First Period (1880-1909).

Ist Block, 150 acres. Shelter fellings at 1-10th of the area, to be repeated three times, so as to meet the requirements of the seedling growth—15 acres a year.
IInd Block, 150 acres. Preparatory cuttings at 1-15th of the area, to be repeated twice in the period, so as to increase the produce and insure the success of the operation, 10 acres annually.
IIIrd Block, 150 acres. Coppice fellings, but taking out also all the old stores and reserving a very large number of young and middle aged ones, (all of hardwood kinds,) 5 acres annually.
IVth Block, 150 acres. Coppice with ordinary store reservation, 1-30th per annum, 5 acres.

Second Period (1910-1939).

I. Cleanings (produce of little value) in young wood from 1—30 years, 5 acres annually.
II. Regeneration fellings in a forest growth already composed of strong shoot-stems and of seedling-stems, and in a soil already protected (against weeds and alien growth) by the cover overhead.
III. Preparatory fellings in a forest of lightly stocked poles from 30—60 years, and intermixed with coppice: 10 acres annually, repeated twice.
IV. Coppice fellings with reservation of numbers of stores, and cutting out of oldest trees.

Third Period (1940-1969).

I. First thinnings. Wood from 30—60 years, 5 acres.
II. Cleanings Wood from 1—30 years, 5 acres.
III. Regeneration. Thinly stocked young forest (grown from seed) 60—90 years mixed with coppice, 15 acres annually, or fellings calculated by volume.
IV. Preparatory fellings: poles mixed with coppice.

Fourth Period (1970-1999).

I. Second thinnings. Wood from 60—90 years, 5 acres.
II. First thinnings. Wood from 30—60 years, 5 acres.
III. Cleanings. Wood from 1—30 years, 5 acres.
IV. Regeneration. Young high forest from 60—90 years, 15 acres annually, or cuttings by volume.

If this schedule should appear at first sight complicated, it is only at first sight; in reality it is very simple, and in practice will

be found to work very easily: it does not (in theory) suppose the existence of conditions of growing stock other than those which are easily attained in practice, especially if the forest to be transformed has been worked previously in several coppice-series. The necessary conditions are in fact, only to have, for certain periodic blocks and especially for the third, a scale of ages, from 1 to 30 years at least, so as to allow a good choice of stores to be reserved in each year of the working, and whose age at the time will be at least 30 years.

It is desirable as far as possible to group together in the first block, those parts of the forest which contain the most natural seedlings—these are often met with in abundance among coppice growth, especially where there has been a more than usually large reservation of standards, and in constituting this block it will also be desirable to do whatever is possible to assure the success of the regeneration fellings when they begin.

If this necessary state of things is not to be attained at once, the method we are discussing may still be followed, only that before commencing the regeneration fellings, we shall have to allow an additional term of years, for getting the stock into a state fit for them.

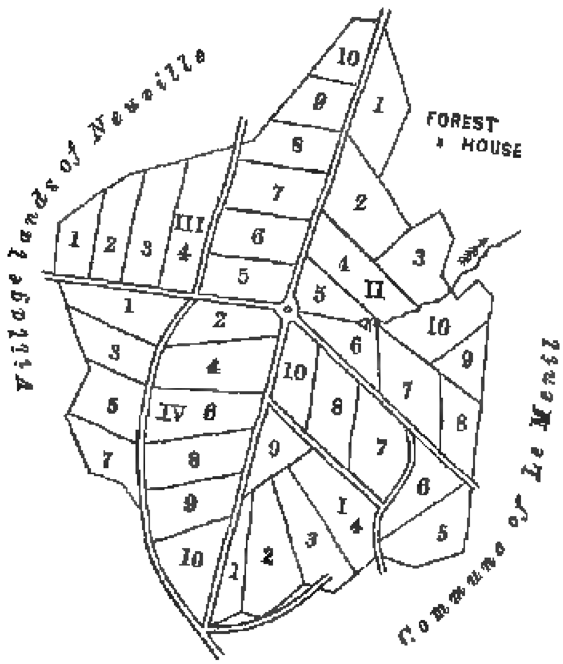
This necessitates commencing operations without preparatory fellings over the portions which belong to the first periodic block, such work being done during a preliminary period, not counted in with the 'conversion-rotation'; and therefore *pro tanto* the period necessary to complete the transformation is prolonged.

The 'mixed method' may, therefore, be accepted as a general one, and one that is elastic enough to be applied to the various differences which coppice forests exhibit. There are many cases where no such period of preliminary preparation is necessary, and when we find the state of preparation already existing in certain compartments, which have become abundantly stocked with reserves owing to the wise economy of the proprietor.

If the plan of working is well followed out, we shall be almost certain to be able to avoid any serious diminution in the yearly produce; perhaps not indeed in *volume*, but at any rate in *value*. Therefore it will be without any notable sacrifice that we shall ultimately attain the object in view: and although the time may be long, in the end there will be the increase to the capital value of the property which results from the conversion.

This mixed method is also of more general and more certain applicability than either of the preceding ones: the only condition essential for success, it pre-supposes, is, that the forest has a growth of hardwoods (fit to form a timber forest) in sufficient proportion to give rise ultimately to a growth which will give seed over the whole extent. It will suffice however for this, that the coppice contains 1-5th hardwood. If this is not so, then, no doubt, we shall have to resort to the assistance of artificial planting.

The control-register is very easy to keep up, and is easily adapted to the general formula we have indicated: care must be taken to keep a special account of each felling-operation separately,—shelter fellings, the preparatory fellings, and the coppice fellings, as mentioned at the close of Part II. (Stored-coppice management).



The "coupes" may be marked out on the ground, which will greatly facilitate the execution of the transformation, and also the verification of the manner in which it is being done.

With a view to diminish expense, it may suffice to limit ourselves to marking out each periodic block into 10 compartments, which will be numbered

I. 1,	I. 2,	...	...	...	I. 10
II. 1,	II. 2,	...	...	...	II. 10
III. 1,	III. 2,	...	...	...	III. 10
IV. 1,	IV. 2,	...	...	...	IV. 10

These will serve, one for the shelter felling, ⅔rds for the preparatory felling, ⅓rd for the coppice felling, of each year.

Of the Reserve.—This partition into 10 compartments, besides the merit of economy, possesses also this advantage, that it enables

as to keep a *reserve* for unforeseen requirements, a matter of great importance in private and communal forests.

Communes are often obliged to keep something to fall back on in case of an extraordinary demand on the treasury; and for this purpose the law has compelled them to keep "the fourth in reserve." It would, therefore, be unfortunate if we could not include such a provision in devising the plan of transformation.

In communal forests the reserve ought to equal the fourth of the produce, but the preparatory fellings being only a kind of thinning and not productive of much, we cannot bring the idea of reservation to bear upon any but the principal fellings which are still those of the coppice. Up to the moment when the fellings begin to be made by volume, and when the reserve will be *previously deducted from the amount of material to be removed*, we provide for the reserve by keeping back one-fourth of the area of the "coupes" of the Ist, IIIrd and IVth periodic blocks.

Thus, in the first block, three of the ten 15 acre-compartments are destined to furnish four groups* of fellings of 11¼ acres, the three first being the annual cutting (after deducting the reserve), and the fourth the reserve itself, and these are cut out in three years.

For the IIIrd and IVth blocks, we take one compartment (15 acres), to make four felling groups of 3¾ each, these are worked in 3 years, the first three for the ordinary, the fourth for the reserve cutting.

The control-register will enable us to follow at a glance, where the reserve, thus deducted from the area, comes. Every three years we shall subdivide (by survey-measurement) into four equal felling-groups, three compartments from the first, and one each from the third and fourth periodic blocks.

The fellings made in the process of transformation are only of a temporary character; and it cannot matter much whether we make some of them a *little* sooner or a *little later* (*which is* what we do when we arrange a reserve). In this way there is a reserve always at the disposal of the proprietor, whenever he wants it.

§ 2. *Conversion of irregular stored-Coppice.*

In practice, the operations of conversion do not always present themselves in that state of theoretic regularity we have assumed in our example. It was important, however, not to complicate our explanation by taking, at first starting, an example other than a regular and normal one.

---

* The block being in the example 150 acres, the 10 compartments will each be 15 acres; 3 of them, total 45 acres, are grouped into four felling groups of 11¼ acres each.—(TR.)

It may be that the coppice to be transformed is very irregular: it may be that some cuttings for conversion have already been begun, or some attempts made to introduce young growth of conifers—so that in those places there is no opportunity for coppice management; or other special circumstances may exist at different points throughout the forest area. Very numerous and very various are such circumstances; but then it is easy to modify our plan of operations accordingly.

The forester will have to make such principles as we have just explained only the basis of his plan, and will combine them with planting or other works rendered necessary by the state of the forest: but he will always divide out his area on the ground, so as to conform to the main outlines of his future working-scheme. He may have to include in his IVth periodic block some groups of young forest, instead of having it all coppice-coupes. In the first block may be included places where a young seedling growth has already succeeded, and where the regeneration fellings belonging to that period will not be required.

He will borrow from the true high forest aménagement (working scheme) and from the several methods of conversion, the combinations necessary to draw up his plan as a whole. Such irregular aménagements necessarily require long experience and skilled judgment for their successful elaboration.

Example.—It is in such aménagements as these, that we may have to put the forest under a preliminary period of management before we enter on the actual conversion of rotation. Suppose, for example, we have a communal forest of 600 acres, of which the fourth (hitherto kept as the reserve) of 150 acres, presents a good growth of beech stems of 70 years, intermingled with older trees, and the rest (450 acres) has been cut for coppice at 30 years, at the rate of 15 acres annually. Suppose that as the result of some experimental attempts to transform this into high forest, the first ten coupes (150 acres) present a growth of young stems from 30-40 years and sufficiently regular, the other 20 coupes (300 acres) being irregular coppice in a bad state; the object is to transform them into high forest with a rotation of 120 years. In this case we shall divide the forest into six divisions of about 100 acres each, which at a later stage will correspond to six periodic blocks, one for each 20 years of the rotation: our first division will contain the 100 acres of reserve aged 70 years; the second will be made up of the remaining 50 acres of the reserve of this age, and of 45 acres out of the ten coupes which have been thinned out and which are 40 years old; the third will contain the other seven coupes of the same kind, aged 30 years, and will give 105 acres: the fourth, fifth, and sixth are furnished by the 300 acres of bad coppice. We must then have a preliminary period of 30 years, during which the coppice system, with a rotation of 30 years, will be maintained in these three

blocks. The yield during this time for the whole forest will be—

1. In the first three blocks only certain trees will be felled, to the extent of 1-30th of the actual volume.
2. In the last three blocks coppice fellings, 10 acres annually, assuring the re-stocking of the cut out area by artificial sowing or planting.

During this preliminary period the 'fourth in reserve' will be secured by a deduction of 1-3rd on the volume of the material which is to be extracted from blocks I.—III., without interfering with the removal of the coppice.

At the end of the preliminary period of 30 years the forest will be in a condition to be worked on the basis of the final working scheme, because it will have the following constitution;—

Periodic block.	Area.	Age at present (1880).	Age at the conclusion of the preliminary period (1910).	Period for felling.	Age at time of felling.
I.	100	70	100	1910—1929	110
II.	50	70	100	1930—1949	130
	45	40	70		100
III.	105	30	60	1950—1969	110
IV.	100	between 30 and 1 year.	20—30	1970—1989	90—100
V.	100		10—20	1990—2009	100—110
VI.	100		1—10	2010—2029	110—120

NOTES FROM REWAH.

TO THE EDITOR OF THE "INDIAN FORESTER."

DEAR SIR,—Having been encouraged by "B. P." in his remarks on page 68 of the Forester for February, I have striven for some time past to forward a few notes on the forests of the above State. But until now my good intention has remained *in embryo*, partly owing to a press of work and partly to that reluctance felt by every inexperienced writer for going into print.

Where is Rewah? I can imagine a good many readers asking; and doubtless, the extensive country bearing this name, except to the administrative staff, and an occasional party of sportsmen who visit the State for tiger shooting, is nearly unknown to Europeans. Its situation may be described in a few words. All that portion of Central India contained between the North-West Provinces on the north, the wild forest country of Chutia Nagpur on the east, the Central Provinces on the south, and the East Indian Railway line on the west, comprises the State of Rewah. The traveller journeying up-country from Bombay would most probably have dined at Jabalpur, smoked his post-prandial cheroot and struggled through some four hours of rather disturbed rest by the time the mail train reaches Satna, where it would be necessary for him to turn out if his destination were Rewah. Satna is midway between Jabalpur and Allahabad, and is the head-quarters of the Agency appointed for the management of the State. The station can boast of no beauty or interest, the traveller need regret having missed, owing to the nocturnal hour of his arrival. It is situated in a plain of light coloured thirsty looking soil, out of which crop, some five miles to the south, a range of low bare flat-topped sandstone hills, one of which is conspicuous for its resemblance to Vesuvius, a resemblance very striking, when a cloud resting on its summit gives the idea of smoke; and in other ways, our station is only distinguishable from the very uninteresting surrounding country by a few hideous railway and civil buildings and the P. A.'s decorated flagstaff. It would be wrong, however, to judge Rewah from the dismal appearance of its western border land.

Thirty-one miles east of Satna, with which it is connected by a well bridged and metalled road, lies the native capital, that gives its name to the State. The city, which it will be convenient to make the starting point for our subsequent inspection of the forest country, is built on a considerable river called the Beehar, a tributary of the Tons, better known on account of its splendid waterfalls, some of which have a sheer drop of nearly 400 feet. It contains 22,000 inhabitants, mostly Hindus, and is a medley of ill-arranged streets, in which fairly built stone houses jostle the meanest mud hovels. Through its centre runs the one broad, well drained thoroughfare, in which most of the

notables and respectable shopkeepers live, and at the far end of which, but separated from it by an old wall and massive timber gateway, stands the Maharajah's palace, a building of no artistic merit and rather shaky in its details.

The young Chief, who is at present a minor, only 7 years old, belongs to a clan of Rajputs, or Thakurs* as the people of this State prefer to style themselves, called Baghels, from whom the country obtains its name of Baghelkhand. The upper classes are either Baghels or members of the allied clans of Bandels, Chandels and Chowhans; and very proud are they of the native equivalent to the *Civis Romanum sum*, with which they tell you on enquiry that *ham Baghel hain*, as if therein lay their claim to every distinction. The poorest of them always wear arms, and consider themselves the Maharajah's *bhai band*. As a rule they are very ignorant, very narrow minded, and staunchly conservative and opposed to every new administrative reform; but if rough and obstructive they are by no means bad fellows, especially if removed from the influence of Court intrigues. Should they object to your procedure they will readily tell you so, and plainly inform you that they intend doing all in their power to thwart and bring it to naught; but on the other hand they bear one no grudge for doing one's duty, even when the performance of such is adverse to their interests, and do not visit upon the servant of the durbar the spleen they may feel towards itself. For instance, I have never experienced from them the inconvenient treatment with regard to supplies for the camp that used to be the common misfortune of a Forest Officer in the Central Provinces in former days, when to keep one without grain and other necessaries until dark was the not unusual method chosen by a *malguzar* for showing his disapproval of the forest *nuisance*. On the contrary, the *talukdar* in whose *illaqua* one is marching generally comes into camp to pay his respects, do a bit of shooting, and have a crack on things in general.

Away beyond the city of Rewah, breaking the sky line from east to west as far as the eye can see, run the Káimurs, a precipitous range of hills of no great breadth, that divide the State into two unequal halves, the conditions of which are as different as well can be—the country on the north being a well cultivated plateau, dotted with flourishing villages and fine mango or tamarind groves, while on the south it is broken up into a complex network of forest covered hills and valleys, in which cultivation unfortunately bears a very inadequate proportion to waste land. It is with this latter portion of Rewah, which contains an estimated area of 10,000 square miles, that I shall attempt to make your readers acquainted. But before crossing the Káimurs, I must mention two small forests situated on the north of the range which deserve passing remark.

* In Rewah the term Rajput is only applied to the illegitimate son of a Thakur.

The first of these is an area of alluvial deposit about 3 square miles in extent, formed in the angle of two rivers. It is covered with forest of teak, mixed with *B. frondosa*, *Alangium Lamarckii* and a little *U. integrifolia*, the teak being the dominant species. The forest was formerly protected as a shooting cover; but of late years, owing to the impecuniosity of the durbar and the increasing value of timber, a contractor was allowed to convert a great portion of its teak into sleepers. He managed to remove 8,000 broad and 36,000 metre gauge sleepers, or 82,000 cubic feet of wood before the arrival of a Forest officer checked his career, and of course the work was carried out on the ordinary contractor system, entailing the maximum amount of damage to the forest, with the minimum amount of payment to the State. Trees were cut down at breast level, wood-cutters being then allowed to hack up the green stumps for fire wood. Or in many cases, where to fell the stout old trees would have caused unnecessary trouble, they were merely deprived of their branches, or so many of them as would yield a sleeper width, while the thick but too short trunk was left to record the contractor's economical procedure, and to greatly increase the expense of carrying out future works of improvement.

The forest is still estimated to contain nearly 40,000 cubic feet of teak, from which scantlings large enough to yield broad gauge sleepers can be obtained. Several trees still standing are over 6 feet in girth with a clean bole of 15 feet below the branches, and many others run up to 20 and 25 feet, with a girth of from 4 to 5 feet; but these latter are seldom symmetrical. One old fellow, locally known as *Rajah Singh* (a name given by the late Maharajah, who once shot a tiger at its base), is over 12 feet in circumference, and would yield a log of wood 12′ × 3′ × 3′; and I am informed by the working assistant of the contractor above mentioned that, the trees cut down by him were much finer than those now standing, and averaged at least a girth of 5 feet, a statement corroborated by the presence in the forest of such stumps as were not split up for firewood. From which it would appear that the area in question is capable of bearing fairly large timber, and must have been very valuable in proportion to its size. And this appears worthy of remark, seeing that the forest is situated nearly on the extreme border of teak limits; in fact in this direction is the most northern bit of naturally grown teak in India. Makandpur, an adjoining village, from which the forest takes its name, is in Lat. 24° 25′, which I believe is a little farther north than the town of Saugor in the Central Provinces, near which is another small area of teak constituting the Reserve of Gurrahkota. The most northern limit of this species is, according to Dr. Brandis, 25° 30′.

Sleeper work is now rapidly causing all the remaining large teak in Makandpur to disappear, and this time next year, beyond a few seed bearing standards, its glory in big timber will

have departed. But care is being taken to fell the trees level with the ground, and to shape the stools for coppice reproduction. The area now being worked over will be protected from fire and cattle, and it is hoped that by the time the young Chief attains his majority, the forest will again be in a fair way towards producing valuable timber. The demarcation of the area, including the erection of masonry pillars, has been completed.

The second area of forest above noted is close to the town of Govindgurh, 11 miles from Rewah, and is situated on the northern slopes of the Káimur hills. Like Makandpur it owes its existence to the sporting tastes of past Baghel rulers. It is only remarkable for the presence of sarái (*S. robusta*) which makes its appearance in this direction. The forest chiefly consists of *A. latifolia, L. parviflora, B. frondosa, S. robusta, T. tomentosa, D. Ebenum, N. Arbor-tristis, D. stricta,* and a little scattered teak. It is the only place where I remember having noticed teak and sarái growing together, even in small quantities; and the teak, as might be supposed, consists of only a few poor specimens, the last struggling members of a species that 5 miles away is dominant over the forest, but which, in the direction we are now going, is absolutely unrepresented.

This patch of hill jungle contains no large timber, but is a useful depôt for supplying the ordinary household and agricultural requirements of the neighbouring towns and villages. It extends over the hills for a length of about 10 miles by 2 broad, forms good cover for sambhur and pig, and is generally the head-quarters of a tiger. At the foot of the hills is a swampy bit of open forest, called Jhirria, in which the late Maharajah organized his large drives for game. Jhirria takes its name from certain springs which have their birth here, and contains the only water for miles round. It is cut off from the hill forest above by a wall over 2 miles long and 8 feet high, having at intervals fairly broad openings through which animals, coming down from the hills, enter, to drink at the springs and graze on the sweet grass which is abundant in the neighbourhood. All through the night before a drive, watchers are posted at the openings in this wall to observe the animals pass through, and then before day breaks, large fires are lighted at all points of exit to prevent them breaking back to the hill, the flanks being guarded by a large body of beaters. The wretched brutes are thus entrapped between a high wall on one side—that nearest the hills—and the cultivated plain, and a host of yelling devils on the other three. On the following day the sportsmen (?) take up their places in small towers commanding the openings in the northern wall, and the animals are driven towards them. Of course the result is a butchery, in which the Thakurs spare neither age nor sex, and by which, were it not for their bad shooting they would soon exterminate all game in the vicinity. But since the death of the late Maharajah, these drives are allowed

only on certain occasions, when Rewah is visited and expected to provide a tiger, &c., for a brace of distinguished globe trotters or a day's shooting for the Agent, Governor-General of all the Central Indian States.

J. M.

(*To be continued.*)

III. Notes, Queries and Extracts.

Cabinet Woods and their value.—The following conversation culled from an American exchange, gives some useful information about walnut and other hardwoods:—

"The demand for fine woods," said one of the members of a well-known Centre Street firm, "is increasing every year. The finest and costliest is French walnut, which, by the way, is not French at all, but is a product of Oriental countries. It grows in Persia, Circassia, and Asia Minor. You have seen it in veneering upon costly furniture, but you probably have no notion how expensive it is, nor how careful we are to prevent waste in its use. Come into our work rooms and I will let you see it in process of cutting."

He led the way into some extensive rooms, where ponderous machinery was revolving and heavy chains rattling. In one room steam rose from cracks in the floor.

"Down there," said the gentleman, "is a pit where we lay large and valuable logs and subject them to the action of steam until they become almost as soft as butter. Then we take them out, fasten them to an iron beam (here he led the way into another room), and this beam revolves around a finely-tempered knife of the same length as the log."

With each revolution a strip of wood was shaved off smoothly, and laid in piles upon the floor like skins of leather or sheets of paper.

"Every time this beam turns around it moves a fraction of an inch nearer to the knife. The whole apparatus works with extreme precision. No printing press or weaving machine is made with greater nicety. The knife that shaves off the sheets of wood is rigidly immovable, and ground to a razor-like edge. The heavy beam that revolves with its great load of timber is firmness itself, and is regulated like clockwork. The slightest tremor in the beam or knife would break and twist the thin sheets that you see turned off here with the regularity and perfection of newspapers turned out by the printing press. These sheets are about 1-120th of an inch in thickness, but frequently we shave off veneers as thin as 175 to the inch."

He lifted a corner of one of the long sheets, and it seemed to be about the thickness of ordinary writing paper. The wood was warm and pliable.

"It is only in this condition that this shaving process is possible. When fresh from the steam pit the knife slips easily

through it. Were the wood cold and hard, the process would be impossible. Even if the knife could do the work, the sheets would be too brittle, and would crumble into small fragments."

"For what purpose are these extremely thin sheets used?"

"The veneers used upon furniture are, as a rule, somewhat thicker than these that we are now turning off. The thinnest veneers are used on picture frames. They are as thin as the finest tissue paper, and must be backed with ordinary paper attached with paste, to prevent the glue by which they are fastened to the body of the frames from showing through. These veneers are also used to a large extent in the same way that wall paper is used—for covering the walls of rooms. Besides this, there are many other and novel uses to which they are put. A short time ago somebody conceived the idea of having business cards printed upon them, thinking that the novelty of the material would cause people to preserve the cards."

"Do you ever saw logs into such sheets?"

"Sometimes, but rarely with the more expensive woods. Sawing involves a good deal of waste. For the cheaper woods it is sometimes more desirable, as it is not necessary to go through the steaming process when we use the saw, but there is a great difference in the number of sheets that are turned out in that way. The most that we can get by sawing is twenty-five to the inch.

"What is the value of the French walnut?"

"I have seen it sell as high as 2 dols. a pound. At the Paris Exposition for 1878 one burl was sold for 5,000 dols., and its weight did not exceed 2,200 lbs."

"What is a burl?"

"This is a trade expression, and means the large and tough knots or excrescences like warts that grow upon the trunk of the tree. The French walnut is a small tree, crooked and dwarfed in its growth, that grows, as I have stated, in Asiatic countries. Its value is confined entirely to these curious, tough, and contorted bumps that grow upon it. The trunk itself is of little or no value. You have often noticed the singular grain that French walnut has, if grain you can call it. The fibres and tissues seem to be twisted into the most singular and complicated figures. The intricacy of these figures, combined with their symmetry, is one of the elements that determines the value of the French walnut burl. Colour and soundness are other elements of value.

"Does the burl play the same important part in mahogany and other valuable woods that it does in the French walnut?"

"There are rosewood and mahogany burls, but, unlike those of the French walnut, they are of little or no value. In those woods it is the trunk of the tree that is prized, the knots are discarded."

"How do other woods compare in value with the French walnut?"

"Next to French walnut, ebony is probably the most valuable. Occasionally a fine piece is found that brings even a better price than the French walnut. Not long ago I saw some that sold for 350 dols. a ton. For a particularly large piece, even five dols. a pound *might* be paid. In ebony the main thing is size. It is difficult to get large pieces that can be used without cutting. Rosewood and mahogany are always in demand. The best mahogany is that of San Domingo. Next come the mahoganies of Cuba, Honduras, Mexico, and Africa. There is much less difference in value between different mahoganies and rosewoods than between different specimens of ebony and French walnut. Fair rosewood will sell in the log for 5½ and 7 cents per pound. French walnut can occasionally, if poor, be bought as low as three cents per pound, but the finer burls will sell for hundreds of dollars. Burls worth from 500 dols. to 1,000 dols. each are not rare. I recently bought one myself for 1,200 dollars, and think I shall make it pan out 3,000 dols. We must be very careful, however, in buying these burls. Their value is often greatly lessened by the existence of hollows, sometimes in the very heart of the wood, the result of decay or malformation. These hollow places are filled up by fraudulent dealers with a substance that is made to resemble the genuine wood, and they will then sell the burls as sound. Manure, compressed to the requisite degree of hardness, is much used for this purpose. Worse even than this is the practice to which such knaves sometimes resort of placing stones in the hollows to increase the weight, for the burls, as I have already intimated, are sold by the pound. This fraud is liable to cause serious damage to the valuable knives that are used in cutting the veneers."

"How about our native woods? Do you deal much in them?"

"Yes, to some extent; but for choice cabinet work the foreign woods are, of course, more highly prized. Burls in ash and maple are plentiful and cheap, selling for two to four cents a pound. Black walnut burls command a higher price—ten to twelve cents a pound—but they are getting scarce. Yes, the demand for choice cabinet woods is constantly increasing. In the houses that the wealthy are now putting up, the fine woodwork constitutes a large item in the expenditure. Look at these veneers for table covers. These handsome designs and this artistic ornamentation are all mosaic work, made by piecing together small fragments of woods of different colours, or inserting them in the body of the large sheet that constitutes the background. To one not acquainted with this work it would look like a drawing on wood; but turn the sheet over and you see the lines run through. You can get these veneers for fine tables at almost any cost. You can get one as low as 25 dols., and you can have designs put together at as high a price as you may care to pay."

"Are there many dealers in such woods in the United States?"

"The number is very small, but the business is large and the competition keen. One of our firm makes frequent trips to Central America and elsewhere to look for rare specimens of cabinet wood. These trips have their attractions, but they are not unfrequently accompanied by hardships and danger."—*Timber Trades Journal.*

SIR,—At p. 720 of your March No. of the *Tropical Agriculturist*, you take me to task for not giving the scientific names of the trees which I enumerated by their vernacular ones, as producing woods fit for tea boxes. So I send you the list with the native names perfectly corrected as to spelling. The misprints were chiefly made by the "Indian Forester," I see.

J. S. GAMBLE.

Indian Names.		Botanical Names.
Toon,	... 1.	*Cedrela Toona, microcarpa* or *glabra.*
Lampatia,	... 2.	*Duabanga sonneratioides.*
Semul,	... 3.	*Bombax malabaricum.*
Gogoldhup,	... 4.	*Canarium bengalense.*
Kadam,	... 5.	*Anthocephalus Cadamba.*
Mandania,	... 6.	*Acrocarpus fraxinifolius.*
Mainakat,	... 7.	*Tetrameles nudiflora.*
Udal,...	... 8.	*Sterculia villosa* (bad).
Kabashi,	... 9.	*Acer Campbellii or lævigatum.*
Mahua,	... 10.	*Engelhardtia spicata.*
Gobria,	... 11.	*Echinocarpus dasycarpus.*
Chilauni,	... 12.	*Nyssa sessiliflora.*
Lepchaphal,	... 13.	*Machilus edulis.*
Tarsing,	... 14.	*Beilschmiedia Roxburghiana.*
Salai,	... 15.	*Boswellia thurifera.*

Madras, 3rd April, 1883. —*Tropical Agriculturist.*

DURABILITY OF WOOD IN BUILDINGS. Herr Weise, Forest Inspector at Eberswalde (Germany), says a contemporary, has recently published a summary of his observations bearing on the above subject. He considers that the system now usual for the supply of wood is in some measure to blame for the complaints which are from time to time made by experienced authorities as to the reduced durability of modern woodwork. He remarks that in the Middle Ages the whole of the wood for any large building was carefully selected from one spot, and after being felled was stored and dried together, a certain homogeneousness in the woodwork being thus obtained. Now-a-days wood is used just as it is delivered by the dealer; coming from various districts and having been felled at different seasons, these circumstances causing a more or less marked divergence in quality. He remarks that the first tendency towards decomposition shows the disadvantage of using various qualities of wood together, and

calls attention to the fact that microscopic observation of the approach of decomposition is not by any means as much used as it might be. He considers that the development of agriculture and the neglect of the judicious extension of forests have exercised an unfavourable influence upon the quality of wood in modern times. In illustration of this assertion he cites the fact that trees yielding 35 inch planks (such as are to be found in the castle of Fuessen) can only be exceptionally found even in forests under Government control.—*Timber Trades Journal.*

DURABLE TIMBER.—The trusses of the old part of the roof of the Basilica of St. Paul, at Rome, were framed in 816, and were sound and good in 1814, a thousand years. These trusses are of fir. The timber work of the external domes of the Church of St. Mark, at Venice, is more than 840 years old, and is still in a good state. Sound logs are dug out of bogs where they have lain for an indefinite period. But the best seasoned timber will not withstand the effects of exposure to the weather more than twenty-five years, unless the surface is protected by paint, or some other coating to keep out the damp, or the wood is treated by some preservative process.—*Timber Trades Journal.*

MR. Campbell writes thus from Gorakhpur:—"Our sissu planting we have now reduced to the following formula:—*Long uninjured roots, deep holes, subsurface watering.* With this method we have obtained astonishing results. A young sissu planted out eighteen months ago as a two-year old seedling is now 23 feet high with a girth at 1 foot from the ground of 10 inches. Hundreds of others planted out at the same time are 20 feet high and many thousands from 12 to 16 feet. Only 40 per cent. of the plants lose their leaves as the result of being put out, and from 5 to 10 per cent. ultimately die. Each thoroughly established seedling, requiring no further care except protection against monkeys and fire, costs only 1 anna. Sissu is extremely valuable in these parts, the price per cubic foot ranging from Rs. 1-8 to Rs. 2. So we are growing our sissu purely for timber: we have so much firewood that it is a regular drug in our northern forests."

THE
INDIAN FORESTER.

Vol. IX.] August, 1883. [No. 8.

Mr. BRANDIS' RETIREMENT FROM THE SERVICE.

In publishing the following extract from the "Review of the Forest Administration in the several Provinces under the Government of India for the year 1881-82," we beg to say that a series of articles on Mr. Brandis' work in India, is in course of preparation, and will appear from time to time in our pages. Meanwhile we have thought that the following short abstract of his services will prove grateful to our readers :—

The most important event in Indian Forest Administration during the year 1881-82 was the retirement of Mr. D. Brandis from the office of Inspector-General of Forests, consequent on his deputation on special duty to the Madras Presidency. Mr. Brandis made over charge of his office on the 15th October, 1881 ; he remained in Madras until January 1883 when he proceeded on three months' privilege leave, at the end of which period he joined at the India Office in London, in order to assist in the reorganization of the arrangements for the education of the candidates for the Indian Forest Department ; and since then he has finally retired from the service.

Mr. Brandis was appointed Superintendent of Forests in Pegu, British Burma, in January 1856, and in 1857 the forests of Tenasserim and Martaban were added to his charge. In December 1862 he was placed on special duty under the Government of India to assist in organizing Forest Administration in other provinces; and on the 1st April, 1864, he was appointed the first Inspector-General of Forests to the Government of India. This appointment he has held for the long period of 19 years.

While holding the appointment of Superintendent of Forests in British Burma, Mr. Brandis thoroughly explored the teak forests of that province, and put their administration on a satisfactory footing. It was due principally to his determination, under great difficulties, that these valuable estates, which yield now an annual revenue of 22 lakhs of rupees, were saved to Government. Since his transfer to the Government of India

in 1862, he has incessantly laboured to perfect the organization of the Department in the various provinces under the Government of India—a task to the performance of which he brought not only a thorough command of details and an accurate knowledge of the requirements of Forest Administration, but a remarkable faculty of adapting means to ends and of varying his suggestions to suit the circumstances of different parts of India. His numerous Inspection Reports and Reviews show at what a cost of personal exertion and self-sacrifice he mastered the conditions of Forest Conservancy in all parts of India; and his directions and instructions will for many years form the standard manuals for the guidance of those who may come after him.

Services similar to those which he has rendered to the Government of India have been given by him to the cause of Forestry in the minor presidencies also. In 1869 he was deputed to Bombay, and the organization of the Department in that presidency, which has worked remarkably well, is based on the proposals made by him. Mr. Brandis' deputation to the Madras Presidency in October 1881, to confer with the Local Government on the whole subject of Forest Conservancy and Forest Legislation, entailed on him an amount of hard work and exposure which few men of his age would have cared to face, and which only his enthusiastic devotion to his profession would have induced him to undergo. The result of his mission to Madras has been to place the establishment of Forest Administration in that presidency on a sound footing, and his services have been acknowledged in the warmest terms by His Excellency the Governor in Council.

All legislation which has taken place on the subject of Forests in India has been carried through on Mr. Brandis' advice and with his assistance. In 1865 the first Indian Forest Act was passed, which defined the legal position of Government Forests and provided for their protection and better management. This Act was amended in 1878, when the present Indian Forest Law, Act VII. of 1878, came into force. It has been extended to the provinces under the Government of India and to Bombay, but not to British Burma. In 1881 a special Act for Burma was passed, and in 1882 the Madras Forest Act received the assent of His Excellency the Governor General in Council.

Scarcely recovered from a severe illness, contracted in the performance of his arduous duties in India, Mr. Brandis was employed in England, for about 18 months from October 1872, in continuing and completing an account of the Forest Flora of North-West and Central India—a work of the highest literary excellence, and which is of the greatest use not only to Forest Officers in those parts of India, but also to Indian Botanists. He was also instrumental in causing the preparation and publication of several other works of the highest importance

to Forest Officers. Amongst these are the "Forest Flora of British Burma," by S. Kurz, the "Manual of Indian Timbers," by J. S. Gamble, the "Manual of the Land Revenue Systems and Land Tenures of British India," by B. H. Baden-Powell, and the "Manual of Jurisprudence for Forest Officers," also by B. H. Baden-Powell.

Throughout his service Mr. Brandis has laboured to create a competent and efficient staff of superior and subordinate officers. The science of Forestry, in its true meaning, being little known in this country when conservancy measures were first commenced, Mr. Brandis arranged, while in England in 1866, under the orders of Her Majesty's Government, for the professional education of the candidates selected for the Indian Forest Service.

Having thus provided for the recruiting of the superior staff, Mr. Brandis set to work on the establishment of an Indian Forest School, in which a competent staff of Rangers, or executive officers, could be trained. He submitted his scheme for such a School at Dehra Dún to the Government of India in 1877, and in the following year it was opened. Some time elapsed, of course, before the institution could be brought into proper working order, but this has now been accomplished, and it is expected that after the lapse of another year or two, 30 trained Rangers will leave the School annually.

Mr. Brandis has thus, during a period of twenty-seven years, been at work in building up a new branch of the Public Service. The difficulties in his way were very great, and it may be said, without exaggeration, that throughout this long period there has not been a day on which, if not actually incapacitated by illness, he has not been labouring in the cause of Forest Conservancy in this country. Apart from the important advantages which have thus been secured to India, owing to the influence which well-preserved forests exercise on the climatic conditions of the country and the economic well-being of the people, Mr. Brandis' exertions have been accompanied by a substantial pecuniary benefit to the Government of India, the revenue from the Government forests, which amounted to 35 lakhs of rupees in 1864, having now risen to 95 lakhs of rupees.

After a career of such extreme usefulness and merit, it was but right that Mr. Brandis' services should be acknowledged by the Government of India in the warmest terms. The *Gazette of India* of the 5th May, 1883, contained the Notification, dated the 1st idem, copy of which has already appeared in our columns :—

TRANSLATION OF M. PUTON'S AMÉNAGEMENT DES FORÊTS.

CHAPTER II.

Of High Forest treated by Selection Felling.

General Remarks.—I ought to say a few words regarding another mode of working high forests, which for a long time had its warm admirers and then its detractors just as eager, but which has had this merit at least, that it has handed down to us in a fair condition our pine forests and those of mountainous countries generally. I allude to the method called "Jardinage," or selection-felling.

It consists in removing here and there the oldest trees, those which are over-mature, or those which have reached the dimensions at which, looking to the object the proprietor has in view, they are fit to be felled. Such a forest consists of a confused mixture of all ages and all sizes of trees.

The foresters of former days had not very clear ideas on the subject of the constitution of the forest capital; they imagined that the only means of preserving the capital intact was to fix in a rough and approximate manner, the number of trees to be felled in each year.

For example, the old French Forester Dralet contented himself with prescribing the felling of one or two trees on each acre, and to cut, as far as possible, this number over the whole extent of forest. When Dralet speaks of one or two trees, he evidently includes in this number, not only mature trees fit for cutting, but *dead trees, or those in a dying state, whatever their size,** otherwise he would have largely exceeded the production which it is possible to look for in the best high forests.

We have seen that in a forest worked as high forest exploitable at an age of 120 years, the capital of exploitation is a series of growths aged from 1 to 120 years, distributed in detachments over the several unit-divisions of the area respectively (one age on each acre, for example, if the forest consists only of 120 acres) in such as a manner, that the first acre will have on it wood aged 1 year and the last wood aged 120 years.

In a selection forest on the contrary, every acre carries not

* Bagneris' Manuel de Sylviculture, page 109.

only the whole scale of ages from the seedling just sprung up to the timber tree of 120 years, but also the scale of volumes belonging to the several ages from thicket to poles and grown-poles, to the one or two trees which are of exploitable age. Every acre in fact, forms a working series by itself.

It will be gathered from this, that if the number of trees to be felled annually has been suitably regulated, and if the fellings have been made always in conformity with the rule, the capital of exploitation in a selection forest ought theoretically to be *as large in volume* as that of a forest managed by the high forest method. If this material is evenly distributed acre by acre, although the various ages are mixed up together and are not grouped on separate parcels or compartments, still if the scale is complete and without a break, the actual capital must be the same in one case as in the other. This is of course only in theory, but it is necessary to remember the ideal conditions, just as it was in the case of the normal high forest, so that we may be able to make comparisons and justify our practical rules of management.

If then we had a forest the capital of which was theoretically complete, but was disposed as we have just explained, we ought properly speaking to visit every single acre in the forest annually, and cut out the trees in each which have reached the age of 120 years, and such stems as are dying down, so as to make up the fixed number. Now as this was not possible in practice, people contented themselves with cutting the fixed number, say two trees, multiplied by the number of acres (which would be 240 trees in all), *selecting these over the largest area which circumstances permitted.* The next year the cutting was made *in an adjoining* area, in such a way that the whole forest would be gone over in a very few years, from 5 to 10 according to its size.

With such a practice, there is nothing to regulate the extent of the portions of the forest to be successively cut over; it as a matter of caprice or of arbitrary determination, and it was not possible to give a clear account of the material or stock in the forest.

Such then is the actual state of forests which have been worked by selection; we have a confused mixture of all ages and all sizes without any means of determining precisely what is the relative importance or the composition of the mass.

The first step which occurs to the mind, as introducing order into the working, is to confine the yearly cutting, which is made somewhat by guess work, to well defined areas. We divide the forest into a certain number of *divisions*, into ten for example, of 30 acres each, and we indicate them by the numbers 1—10. Out of these divisions we select for cutting the 240 trees (fixed by the former practice), and thus each one loses some of its trees once in ten years. The divisions are arranged

so as to have equal areas* as far as possible, and their size depends on the configuration of the country, the exposure, situation and so forth.

The object of making the divisions, is to keep the felling within certain limits, and thus to make control easier, and to prevent difficulty in selling, or collecting for removal, the material cut. It is therefore the first thing to be arranged in a forest worked by the selection method.

The result will be of course to modify somewhat the manner in which our capital is constituted; instead of having the scale of ages and growths in a mixture over each acre of the forest to be cut at 120 years of age, we shall tend towards completing the scale in each division; in other words, instead of having 120 series to be (in theory) cut over yearly, we shall have ten small series, each to be cut over once in ten years. We have still the same mixture of ages and sizes, but a mixture of the same sort tends to confine itself only to the one division.

Of the capability or maximum annual yield.—Having established our *divisions*, we have to determine the figure at which to place the annual felling, that is to say, to determine the volume of wood or the number of trees which can be cut in each year without trenching on the capital. It will easily be understood, that the area of the division does not furnish us with a basis for calculating the yield, the division being only a matter of convenience, with a view of confining the work in each year to one spot for convenience sake.

People have taxed their ingenuity to find a solution for the problem of the "capability" of a selection forest.

Some, starting with the principle that the capital must in reality be the same in a selection forest as it is in a forest worked by the regular method, when both are fit for cutting at the same age, have thought to determine the annual increment, by taking it as the same as that which is known to be true for regular high forest of the same species, under similar conditions of growth, &c.

They have then diminished the outturn a little in order to be on the safe side. Suppose that a regular high forest in analogous situation and circumstances, produced 2 cubic metres to the acre, they would take it at 1·50 to 1·75 for a selection forest. Multiply this by the area of the forest, and then they had the

* The size of the division is such that the convenience of selling or removing the timber of the year's cutting is not prejudiced, as it would be if we had to go over a very large area for a very few trees. If the forest is very large indeed, we must first subdivide it into working-circles, or into sub-forests so to speak, each of which will have its divisions as if it were a separate forest. Such a plan is convenient in mountain forests, because it permits us to introduce into each "series" certain differences of management, which are likely to be required, seeing how very greatly different parts of such forests vary one from the other, according to the elevation, exposure, &c.

capability of the forest with sufficient exactness. It is indeed true in theory, that the working capital in a high forest must be the same whether it is managed on one method or the other. But that would suppose that the selection cutting was made with theoretic exactitude, and as a matter of fact, "jardinage" is always done with some amount of mere guess work or caprice in the execution; it is therefore absolutely impossible to be sure, that the scale is quite complete, and that there are no gaps in the series of ages, and consequently in the volume of the growing material.

In order to apply the known production of regular high-forest to a selection forest, we must assume that we actually have the whole scale of ages and volumes complete, which is exactly what we do not know, and have not the means to ascertain.

Other enquirers have set about to determine in volume the capital working. They tell us the capital must be equal to that of a regular high forest, and consequently each acre must carry half the volume of the acre arrived at maturity, (*i. e.*, the mean between the volume at 1 year and the volume at 120 years, the mature age assumed in our examples). If an acre of regular forest at maturity carries 200 cubic metres, the total capital will be 100 cubic metres × the area of the forest: in other words, we ought always to have 100 cubic metres on every acre of our selection forest. As these have to be cut at 120 years, they will on an average, have to stand 60 years (the mean between 1 and 120); so that dividing 100 cubic metres by 60, the result will be the "capability" in volume. It is necessary to count up the volume of all the trees of every class standing in the forest; if it comes to more than the theoretical figure, by the above calculation, the excess can be left to form extraordinary fellings to be cut in a certain interval of time: if it comes to less, then the annual cutting must be reduced for each year of the period till a revision of the standing material is made.

Those who have tried in such a manner to determine the capital working, and represent it in cubic metres, have fallen into a double error. In order to assume that the capital is represented by 100 cubic metres, they must first take it for granted, that in a forest worked by the regular method, the material is represented by a scale which ascends in a right line, or evenly, from 1 to 200. Now in reality the laws of vegetation are not known, and in any case the scale does not ascend by a right line, but by a more or less irregularly curved line.

To this first mistake they have added another: which is that the capital does not consist merely of a given volume, but of a scale of age-classes, so distributed that no number in the scale is wanting, and that each exists in the proper proportion. Now in the confused admixture found in a selection forest, it

is quite impossible to determine to what extent such a state of things exists, or how far we are from it; and it might also happen that if there were the normal figure of the volume actually on the ground, that figure might be accidentally made up by a few old trees, or by trees of ages unsuitably graduated. So that in any case we should only have a fictitious standard of annual yield, which could never serve as the basis of a rational or practical rule of felling.

Nothing then has as yet been found, nor is it ever likely to be found, which will enable us to determine the "capability" in the case of a forest worked by selection felling; indeed we might almost say that the determination is incompatible with this kind of management. We may be sure that with such a confused mixture as we have in a selection forest, the material will be widely different from a theoretically proportional arrangement; and the divisions which we establish, to induce regularity, are not likely to be analogous one to the other, either as regards the volume or the series of ages and sizes they contain. When, therefore, we determine to cut annually a certain volume, that is not a "capability," or maximum annual yield in the true sense of the term: it is only a limit which we fix, a rule we lay down, which must not be exceeded. The state of the growing stock must be the practical guide to the forester's conclusions in this respect, and he must be careful not to remove any living tree, but when there are younger neighbours to grow up in its place. Where the treatment itself is empirical and based on practice and experience, it is useless to talk of a yield dependent on calculations.

It will appear presently that the motives for adhering to this selection method are few. Nevertheless, the occasions on which those motives come into play are somewhat frequent.

Under this method, though we are dependent on practice and experience, we cannot depend on finding such perfect wisdom in management in all our forest agents: we have therefore to *find out some means of controlling and safe-guarding our felling* operations.

The only means that can be thought of is to *fix the dimension of the trees to be felled*, taking either the diameter or the circumference; it is then a rule, that no living tree of smaller dimensions is ever to be cut.

The officers in charge will be obliged only to cut trees which have reached or which exceed the fixed dimensions, and can only extend the rule by cutting out trees which, though they may be of inferior size, are quite dead, or in a state of manifest decline.

It may be remarked, that this fixing of a minimum girth or diameter, is rather a fixing of a term at the end of which a tree is mature for removal, than anything resembling a calculated yield.

If you settle that trees of a certain size only may be cut, you in effect determine a degree of utility, which the produce must have attained, or in other words an age before which the tree is not to come down. We should know nothing of a real possible yield, unless we could further fix what number of trees of this size to cut; and we have seen that we cannot calculate this for the double reason—

1. That our ignorance of the laws of growth prevents us from determining the number of stems which a given unit of area carries at each age of their life.
2. That no means exist for determining in the confused mass, exhibited by a selection forest, whether the capital is sufficiently constituted or is superabundant, or is insufficient by reason of gaps in the scale of ages.

I have dwelt at some length on the question of the possible yield in forests worked by selection, in order to show how vain are the attempts to ascertain it, and consequently how necessarily inferior 'selection felling' is as a method of working.

The working scheme.—The impossibility of determining, even by estimate, a figure to represent the possible yield, does not, however, prevent us from laying down a scheme of working adapted to the circumstances. We proceed in the following manner: we first divide (according to the considerations already noticed) the forest into divisions, containing as nearly as possible equal areas. Each division corresponds to one year's working in the period fixed (and it should be short) for carrying the selection process over the whole forest.

The divisions should conform whenever possible, to natural divisions of the forest, where the same style of growth, the same exposure, slope or other permanent natural features prevail. In each division all those trees are counted (and the cubic content calculated out) *which will be removed during the selection-period*, because they have either the dimensions fixed on, or are dead or dying. Dividing the total contents by the number of years in the selection-period, we get the mean volume of the annual felling.

Comparing this with the ascertained volume in each division, we have so to cut out the divisions as to *get a pretty equal annual outturn*, taking a deficit in one division from a portion of a division which has an excess, and so on. This last condition, however, is a very secondary one: and in making count of the numbers and contents which will (when added up for all the divisions) furnish the base for calculating the mean annual yield, foresters must remember that to be well within the mark is the best rule in selection-working.

When the selection-period is worked through, a new counting and division of the trees (which have then attained the required size or are dead or dying) will be made. It is not to be looked for that there will be a sustained equality be-

tween the outturn of the successive periods, that is incompatible with selection felling. Even in forest managed on the regular high-forest system, we have already seen that where the capital is superabundant or is deficient, this condition of a sustained equal yield cannot always be kept up, and cannot be in many cases attained even where there is a thoroughly sound plan of management.

All we can say is that if, as we have advised, good forest divisions well marked and corresponding to natural differences of growth and circumstances, have been laid down, and if the felling is rigidly confined to such trees as have attained fixed size, then the conditions of production will tend to become equal in each division, and in time the annual yield will become as nearly constant in amount, as the nature of things will permit.

Of the Reserve.—It may not be useless to indicate how, even in selection-forests, a reserve may be kept in hand: in Communal forests this is a matter of some importance.

If the forest is too small to be subdivided, the simple plan is to leave a certain number of trees standing, although they have reached the standard dimensions for felling. They can be cut whenever the special demand arises.

If, on the contrary, the forest is of considerable extent, it will be possible to tell off certain divisions, one-fourth for example, and leave them uncut, while the ordinary annual felling is going on in the rest.

But as the formation of the divisions tends to give us a number of separate series, each having its own special production and independent of the others, it is much more reasonable to make one separate division, expressly as a 'reserve block.' We shall then have two 'coupes' to manage as in a coppice forest, one, three-fourths of the area of the ordinary felling, the other one-fourth, the reserve. There is nothing to prevent our subdividing the 'reserve compartment' again, so as to regulate the extraction of material within it, counting up the material to be taken out within a given period, and extracting it according to a special plan of its own.

Example.—The working scheme of a selection forest is very simple, and can be easily adapted to the tabular form already recommended for coppice and for high-forest control.

Let us take a forest of silver fir (*Abies pectinata*) of 300 acres, to be felled by selection. The size fixed for felling is 1·60 metre in circumference (measured at 1 metre from the ground), one-fourth is to be kept in reserve.

The forest is divided into six compartments about 37½ acres each, and one of 75 acres is for reserve. The period for going over the whole of the divisions with the selection felling is 6 years. Having counted and calculated the contents of the trees which have attained the required size of 1·60 metre, and the dying and dead trees, we have the following results :—

	c. metres.
Six compartments for the ordinary felling, ...	2,766
(Of which 1-6th would be)	461
For the Reserve, ...	730
(To be cut as required with an annual mean of)	122

The plan of working exhibited in a tabular form will be—

Divisions or Compartments.	Area.	Age at the time (1860).	Period during which the selection cutting is to be made.	Age after the cutting.	Remarks.
		A.—*Ordinary Fellings.*			
1	33	Mixture of all ages and sizes.	6 years—only trees of 1·60 metre or dead or dying to be cut.	Mixture of all ages and sizes below 1·60 metre in circumference.	
2	42¼				
3	38				
4	36¾				
5	35				
6	40				
		B.—*Reserve Fellings.*			
R	75	*id.*	*id.*	*id.*	
	300				

In such forests there is no such thing as a revolution or period of rotation properly so called (page 31). All we can say is that in this forest, trees of 1·60 metre in circumference show an average of 145 annual rings, and we may take this to indicate an age of 145 years: that is all we can determine.

The special plan of exploitation for the period in hand will be as follows :—

Divisions or Compartments.	Area.	Growing stock of all ages, presenting in 1860 timber to be taken out amounting to	Nature of the felling—selection in	Annual average of the fellings.	Remarks.
		A.—*Ordinary Fellings.*			
		c. metres.			
1	33	420	1860	461 c. m. annually.	
2	42¼	590	1861		
3	38	960	1862		
4	36¾	140	1863		
5	35	330	1864		
6	40	326	1865		
	225	2,766			
		B.—*Reserve Fellings.*			
R.	75	730	1860-1865	122	To meet emergencies.
	300	3,496			

Register of the working scheme.—A register will be kept for the selection period (and for each separate working-circle established in the forest) in the form which we have already given as suitable for all kinds of exploitation.

Register for the working period, six years, beginning 1860. (Selection Fellings).

Divisions or Compartments.		1	2	3	4	5	6	Grand Total.	Fellings Ordinary.	Fellings Reserve.	
Quantity to be felled.	Area.	32	42½	38	36½	35	40	300	225	75	Remarks.
	Volume.	c.m. 420	590	960	140	330	826	3496	c. m. 2766 (461)	c. m. 780 (122)	
1860		405	...	...	...	..	...	405	405	...	
1861		...	570	...	...	...	...	570	570	...	
1862		...	...	460	...	...	...	460	460	...	
1863		...	...	500	...	...	...	801	500	301	
1864		...	...	...	140	319	...	468	468	...	

At the expiration of each period, a line will be drawn, and a new account begun, headed by the results obtained by the new counting and calculation of contents. The form of the register will not usually contain any column for "extraordinary fellings," for it must not be forgotten, that the *reserve* is only a part of the ordinary *revenue* or *yield*, set aside to meet unforeseen demands, while an *extraordinary* felling, is a realization of a portion of the capital itself, which circumstances render necessary. It is of course indispensable to take note of such a felling, because there may be a responsibility incurred in making it, for which one may have to answer to another. But in selection forests it is so difficult to determine the maximum annual yield or capability, that it is practically impossible to distinguish what is income or what is reduction of superabundant capital. It is, however, possible to find forests in which a superabundance of growing stock is manifest to the eye. In such a case we have to make an approximate estimate (analogous to that which has been described in treating of regular high forest, where the capital is superabundant) and to make extraordinary fellings accordingly. When such are made, a special

column is added to the account form, and entries made in differently colored ink.

Comparison of this method with that of regular high forest working.—The selection method is inconvenient in so many respects, that it has, as a system for general adoption, been abandoned: on the other hand, it has some compensating advantages, and these enable it to be followed under certain circumstances.

The *disadvantages* may be briefly stated as follows:—

1st.—It produces less in volume than high forest management, because there are no thinnings nor intermediate products, which in a forest managed by the regular method amount to 15 or even 25 per cent. of the principal yield. We do not know whether a stem dominated by another tree will not be called on one day to replace the tree which now checks its growth. In a selection forest we cannot cut out any stems but those which are actually perishing. Moreover, in a selection forest the trees are often badly grown, they overshadow one another and restrict the growth; all these circumstances tend to reduce the production in volume, to a degree which makes it impossible to do more than merely estimate it.

2nd.—It brings in less in money value; that is to say the rate of interest is lower than that of regular high forest, which is already low, since, the production being less in volume, though the capital is theoretically the same, the rate of interest yield is proportionably lowered.

3rd.—The felling not being by any rule of maximum annual yield—not even an approximate one, and therefore not being capable of verification by decennial revisions, has to be conducted within limits of the greatest moderation. We are afraid to look for any increase for fear of deterioration.

The *advantages* on the other hand are—

1st.—The soil is kept continually covered and restored, so that it requires little care, for we never cut a tree which is not replaced by another standing near it.

2nd.—It is easily adapted to forests of small extent; whereas the natural method requires an area sufficient to carry such an amount of stock of each age and size that the requisite treatment may be applied. As in a selection forest the scale is complete on each acre, the area may be very limited without interfering with the working.

From this it follows that this mode of treatment is still followed:—

1st.—In mountain countries, in places exposed to wind and to frosts, where the forester would be very anxious about the results of a regeneration felling: in forest zones intended for defence of lower lying properties, where the object is less to produce timber than to maintain a continuous protection belt of forest.

It is for this reason that forests of silver fir and beech are still worked by selection in mountains, even of inconsiderable elevation, these species bearing much shade and cover overhead. At great heights, forests of larch and pines can *only* be treated by this method. Under these last conditions, where natural seedlings are difficult to produce and slow in growth, we have *always to preserve the growth on the ground*, and only remove trees where there are others ready to replace them.

2nd.—Felling by selection is adopted in woods of small extent belonging to communities and private owners, and stocked with species which do not coppice, like the beech and silver fir, and in which the owners require from time to time stems of different dimensions which they find growing together in the forest.

3rd.—Lastly, the method is followed, as an auxiliary in other spheres of management as a transitory means of making certain groups last, though it is already of an age to be felled entirely, but which has of necessity been placed in an intermediate periodic block or group. It permits dying trees, or those which have ceased to grow, to be removed at the moment when they would begin to lose value, and to replace them by younger trees which promise vitality and continuance in growth among the mass. We have already cited an example at page *187* (*see* Chapter on High Forest, §2. *The case of* an excessive standing crop). Properly controlled then, and managed systematically, the method of selection felling offers certain advantages which are not to be despised; but applied at hazard and without due limitation, it produces frightfully bad forests, and there is an end to working by plan and with due reason.

CRITICISMS ON "NOTES FOR A MANUAL OF INDIAN SYLVICULTURE."

(THE following notes on my definitions have been received from MR. J. L. LAIRD, Deputy Conservator of Forests, Bombay, now on leave in England. Want of leisure prevents me from replying at sufficient length to some of his objections, which appear to me unfounded, hence any short remarks I may make will be given as foot notes.—E. E. FERNANDEZ.)

1. As I understand it, the *bole* of a tree is the whole of its central vertical axis. I would alter your definition to the following:—"The stem of a tree, from the ground to the point at which it begins to fork, is called 'bole.'"

2. "A forest is said to be *pure*," &c.

I would prefer the word *unmixed*. I cannot give any precise reason why, but 'unmixed' seems to me more expressive of the idea you wish to convey. To be thoroughly appropriate, the negative 'impure' ought to be capable of being used to express the opposite meaning; but nobody would, I think, venture to propose that, and you yourself are obliged to have recourse to the term 'mixed.' Under these circumstances, would not it be more natural to employ the word 'unmixed' to express the opposite quality? *

3. "The term canopied forest denotes a collection of trees, of any age, the crowns of which meet."

This definition implies that a forest whose crowns do not meet is not a canopied forest. But surely a canopied forest should mean any forest which possesses a (leaf-) canopy. I do *not think* that the *term is at all expressive of the meaning* given to it, and, moreover, that it is superfluous. At any rate you might insert 'completely' before 'canopied.'

In the next paragraph, I would leave out the word *continuous* in the definition of leaf-canopy. Lower down you speak of the canopy being *open* and *interrupted*. It could scarcely possess either of these qualities, and be at the same time continuous.

I would much prefer the term *leaf-cover* to *canopy*. Canopy not being an ordinary word, it appears a little far-fetched when there is a good homely word equally expressive. Further on (page 100) you speak of a plant growing *under cover*. Why use two words to express the same meaning? The word *cover* may be used to express either cause or effect. In the example

---

* I had no alternative in this matter but to adopt the terms that had been introduced by Dr. Brandis, and which usage had since authorised.—E. E. F.

you give in the last paragraph of page 106, you use the term in the former sense, and then define its meaning in the latter.*

4. "The density of a crop signifies the degree of closeness of the growth constituting it."

I think it would be convenient to have this put into a more definite form. I would, therefore, add:—'The density of the trees on a given area is the ratio of their actual density to what it would be if the area was completely stocked; complete density being expressed by unity.'

If this clause is appended we shall have a convenient term for expressing the quantity of stock on a given area. Thus, when describing the stock in a compartment, we might say its density was ·75, meaning that only three-quarters of the compartment is stocked, or that it could hold one-third more trees than are on it.†

5. In the definition of 'regular forest,' I would leave out the words *conveniently distributed*, so as to make it more precise and objective.

6. "A young plant, which results directly from the germination of a seed, *until it begins to lose its lower branches*, is called a seedling."

I would omit the words in italics. Some trees never lose their lower branches. I have only to look out of the window to be convinced of that fact.‡

7. "A high forest is a forest consisting entirely of seedling-trees."

The term *high forest* is perhaps the very worst we could have borrowed from the Germans. They, themselves, acknowledge that it is as bad as bad can be. A forest composed of seedling-trees is not necessarily high at any stage of its existence, and the term is, therefore, misleading. It is thoroughly artificial, and does not convey a single innate quality of seedling-trees. I think you will agree that *seedling-forest* does, and that it is a much more appropriate and expressive term.§

8. "*To poll or top off a plant signifies to remove its crown.*"

* If the term "leaf-cover" be substituted for "canopy," what would be the adjective equivalent to "canopied"? We have *cover* in the case of a solitary tree as well as in that of several trees which touch crowns. "Leaf-cover" would therefore, I think, be inappropriate to express the idea which I have endeavoured to convey by the word "canopy." As regards Mr Laird's objection to the word "continuous," I have already met it in my reply to Captain Wood. —E. E. F.

† This is a capital suggestion. I myself use the term in my working plans as the equivalent of the "co-efficient of density," a complete crop being denoted by unity. I have, however, omitted all reference to this point, as I thought it belonged specially to the organisation of forests.—E. E. F.

‡ I do not understand the force of this objection. Would Mr Laird kindly give the instance of any tree, which does not loose some at least of its lower branches, even when growing in complete isolation.—E. E. F.

§ Every one will agree with Mr. Laird, but the term "high-forest" has become so thoroughly established in our phraseology, at least in India, that the substitution of another more logical term would probably not be allowed.—E. E. F.

I would add, after 'poll,' *pollard*, as that verb is at least as often used as 'poll.'

I agree with Major van Someren that "off" had better be omitted.

9 "A rotation is the number of years fixed for the successive and complete regeneration of a whole forest."

The word *rotation* is already used to denote successive changes of species. I would much prefer the word *revolution*, which is just as much to the point and has no other meaning for us.

The word *successive* appears to me out of place. I do not see how it can be applied with reference to a single object. I dare-say you did not intend that it should, and that you probably had in mind the successive regeneration of the annual coupes, but this would not be evident to a beginner. I must confess that I do not think the meaning is rendered very clear even if *successive* is left out. I would prefer the following :—"The rotation of a tree, or collection of trees, is the number of years fixed to elapse from the time of its production to the time of its exploitation."

Your definition would, it appears to me, only apply to a series (*i e.*, a forest in which there was a perfect gradation of age-classes occupying equal areas). But, supposing we have an isolated compartment, not being part of a series, whose crop is cut clean periodically every 100 years. In one year the entire forest would be completely regenerated. Hence by the above definition the rotation might be 1 year instead of 100.*

10. I believe you are perfectly correct in saying that *fall* may mean "that which falls." We often hear of a heavy fall of rain, for instance. Nevertheless, I agree with Mr. Smythies that it is not a good term to use in the present case. Would not *cuttings*, which is the expression generally used, answer?

11. The introduction of a verb 'to coupe' into the Forester's vocabulary would perhaps prove useful. It might, for instance, be said that 100 acres were couped in such and such a range during the year, meaning the annual coupes aggregated 100 acres.†

12. "To clean fell a coupe means to remove the entire stock standing on that coupe"

I would prefer putting *clean* after *coupe*.

But how can you fell a coupe? Ought not the words *the crop on* to be inserted after *fell*.

I would also insert *at one operation* after *crop*, because otherwise the definition would apply also to a forest naturally regenerated by seed. The definition would then read :—"to clean fell the crop on a coupe means to remove at one operation the entire crop standing on that coupe."‡

* I admit Mr. Laird's very suggestive and necessary correction.—E. E. F.

† A capital suggestion.—E. E. F.

‡ A very necessary correction.—E. E. F.

13. In the next paragraph, would not *parent-*, *mother-*, or *foster-*crop answer in place of *reserve?* The word *standard* would then be available for the purpose to which you originally proposed to put it.*

14. "A glade is a portion of a forest in which the trees are scattered."

In the ordinary acceptation of the word, does not glade mean a narrow space, altogether free of trees, in a forest? Continuous forests of 'scattered trees' covering hundreds of acres are often met with; would it do to call these glades?

It appears to me that we could do without this term in any technical sense, but if retained, I would suggest the alteration of the definition to something like the following:—"A glade is a relatively small and open portion of a forest in which the trees are scattered and their density less than ·1"†

15. "Dormant buds."

Is not the proper, or at all events the older, term, *adventitious buds?* ‡

If a change, or addition—for which there does not appear to be any necessity—is made, I would prefer the term 'latent' to 'dormant,' because it implies the quality of not being perceptible although present.

NOTES FROM REWAH.

(*Continued from July No., page* 350).

"I WANT you to go down below the Kaimurs and carefully inspect all the forest country in that direction, get acquainted with the people, enquire into their forest rights of *user*, and see whether a revenue can be developed from the sale of forest produce. It is reported that practically inexhaustible forests cover the country in the Chandia and Sohagpur districts, the working of which should yield an income of many thousands. *Some years ago there was also a valuable lac industry estab*lished over the same country, which has since been destroyed, but which might perhaps be re-developed and made to contribute a revenue. Find out all about this and let me have your report as soon as possible." With these instructions to guide me I started into camp in January 1880, spending that and the following season in wandering about the forest-clad portions of the State, taking every opportunity of meeting and

* Some trees of a crop may be spared in order solely to attain a larger diameter; such trees would form neither a parent-, mother-, nor foster-crop.—E. E. F.

† This correction will be considered.—E. E. F.

‡ No, *adventitious* is the very opposite of *dormant*. Of course an adventitious bud may become a dormant bud, if, instead of bursting through the bark as soon as it is formed, it remains concealed under it from year to year. Perhaps the word "latent" (*lying concealed*) is more expressive than "dormant."—E. E. F.

talking with the proprietors and people generally, enquiring into the chance of creating durbar rights, where none had up to the present been exercised or claimed, doing some shooting, and successfully re-starting the lac cultivation over a large area of country. In vain, however, I searched for those practically inexhaustible primeval forests where mature Sarái (sál, *Shorea robusta*) trees were supposed to be growing in innumerable thousands, and herds of elephants were said to be not uncommon. But I must not anticipate.

The Kaimur hills traverse the State for 120 miles in a nearly east and west direction. They consist of a narrow, denuded, and, on the south, extremely precipitous range of sandstone and conglomerate rocks, the result of upheaval, and are nowhere more than five or six miles broad, with a descent on the south fully equal to their height above the plain on the north. The average elevation of these hills is about 1,500 feet, some peaks being over 2,200 feet; and in all their length, within the State, they are passable in only ten or a dozen places, not one of which can be considered practicable for carts. They represent therefore a formidable barrier between the plains on the north and the forest country below the hills. Another considerable range—the Maikals—form with the rivers Nerbadda and Johilla, the boundary of the State on the south, over 100 miles away, where it marches with the Central Provinces. Between these two main ranges the whole country is covered with a sea of sandstone and gneiss hills, broken up and scattered about in the most indescribable confusion; here, starting from a central nucleus and sprawling over the country in ray-like spurs; there, isolated in bold craggy looking citadels which form naturally impregnable fortresses, while in places they trend away in long narrow flat topped ranges or rise out of the valleys in strange steep sugarloaf cones. But they have a tendency to group themselves into ill-defined blocks running north and south at right angles to the Kaimurs and Maikals, and they form the watersheds of the principal rivers flowing into the Sôn. They generally vary from 1,500 to 2,500 feet above sea level, but several peaks are 3,000 feet, and some few exceed 3,600 feet in height. The valleys between these hills are for the most part of small extent and only partially cultivated, while in the whole of this country there is only one small section of road, lately made, about 30 miles in length, which can be called practicable for even the ordinary country cart with its disc-like wheels and wooden axles.

South of the Kaimurs, Rewah comprises an estimated 10,000 square miles of the hilly watershed of the Sôn river, which rising in one of the Feudatory Chiefships of the Central Provinces, flows through the State in a north-westerly, northerly and finally easterly direction, parallel to, and at no great distance from, the Kaimur hills. In this part of its course it receives four con-

siderable streams, *viz.*, the Johilla, Mahanádi, Banás and Gopat, and has an entire length from border to border of the State, of perhaps 300 miles, in which it varies in volume from a small stream a few yards across to a majestic river three-quarters of a mile wide. The Johilla flows parallel to, but some distance south of, the Sôn, from where the latter enters the State to where it bends northwards; and beyond this junction, the Banás and Gopat, after flowing through the southern portion of the State in a northerly direction for some 70 or 80 miles at right angles to the Sôn, join that river at equidistant points down its easterly course, and form, with the Johilla and the main stream, well defined boundaries for six natural sub-divisions of the country. With the exception of the Johilla, all these rivers would be practicable for floating operations during three months in the year. It will be gathered from the above, that the forest country is both very hilly and well watered.

We have seen in a former paper that the vanguard of the great Central Indian belt of Sarái makes its first appearance on the northern slopes of the Kaimurs, which in this direction may be said to mark the boundary where teak ends, and Sarái begins. The former species is just represented on this range, but in the country to the south, up to the Mandlake border, it entirely disappears and gives place to Sarái, which gradually asserts itself, until from a line marked by the river Sôn it becomes the dominant tree over all the valley country remaining uncultivated. The character of the Sarái forest is very similar throughout. The soil is nearly everywhere a more or less—generally more—sandy loam mixed with lime and ferruginous gravel, and the forest consists principally of Sarái coppice associated with *D. stricta*, *A. latifolia*, *B. frondosa*, *T. tomentosa*, *E. officinalis*, *D. Ebenum*, *A. Catechu*, *S. Anacardium*, *M. velutina* and a conspicuous undergrowth of dwarf date *Phœnix acaulis*. The Sarái varies in purity from 10 to 80 per cent. of the entire crop; it overflows the valleys and undulating country and creeps up over the low hills, but is almost absent from the higher hills, where it is replaced with Salai (*B. thurifera*) supplemented with bamboo, *A. latifolia*, *L. parviflora* and *Nyctanthes Arbor-tristis*. But by far the greater portion of this extensive forest is made up of the Sarái coppice and bamboo, the former of which is too small for working purposes, as it does not exceed an average girth of 1½ feet. The forest is nearly everywhere cut into by narrow, sometimes star-shaped, marshy glades, down the centre of which filters a boggy stream forming dangerous *dal-dals* or quagmires, which are often quite impassable. The Sarái never encroaches on these glades, but fringing them, clearly marks the limits of the firm well drained ground. These marshy glades are generally cultivated with rice, and well on in the cold weather, about the end of January, are good places for snipe.

The Sarái coppice is the result of our old friend the *dhya* maker

or *jhumer*, whose indefatigable exertions with those two assistants of his, axe and fire, have nearly everywhere destroyed the high timber forest of Rewah, and not only destroyed them from a working point of view, but I believe greatly changed them for the worse with regard to their present timber contents. It is possible, I think, to trace the extent of his depredations on any particular area from the present character of the forest cover; and I am of opinion that the greater or less exuberance of the bamboo crop is a fairly certain guide here in this respect. In places where the forest is tolerably high and contains a decent proportion of mature trees, and which from natural inaccessibility, a glut of wild beasts, or superstitious belief, have escaped for a long period the visits of *Baigurh* or *Kol*, bamboo is very scarce, often completely wanting. In other places, where, owing to a comparatively good soil, or to special qualities of accessibility, such as the close neighbourhood of permanent cultivation, the *dhya* maker has frequently operated and *jhumed* the forest, time after time in a regular rotation, the bamboo crop, as the outcome of competition and survival, if not of the fittest, then of the most irrepressible, has struggled to the fore, and owing to its superior staying powers has outstripped everything, leaving even the sturdy Sarái nowhere in the race. This transformation from high timber forest in which bamboo is only sparsely represented, to dense thickets in which it forms nearly the entire cover, can be traced in different parts of the State. I remember noticing the same thing in the bamboo forests of Sonawáin on the Sátpuras. In many places in these forests there are considerable areas of nearly pure bamboo, and the whole tract shows very evident signs of having been treated on *dhya* principles within a reasonable period.

Dhya cultivation is here a general custom rendered necessary by the poverty of the hill tribes, a great proportion of whom possess no cattle or agricultural implement better than an axe and hoe; and it is also to some extent the result of a poor sandy soil.

Dhya is of two kinds, first that known as *dhya* proper, which is the ordinary clean felling and burning, in rotation of about 8 years, of the entire forest cover, as practised by the hill *Báigurhs* and *Kols;* and secondly, the custom known locally as *baghor*, according to which, the inferior soils are fertilized by burning over them annually a coating of small trees and branches obtained from the neighbouring forest. The latter is the method preferred by the residents of permanent villages, where the fields treated in this manner are cultivated each year, and when the wood ashes are ploughed in as a manure instead of being utilized as a soil. Now as a large proportion of the forest population consists of the poorest tribes, who at present are nearly dependant on the axe and fire for their grain food, and as the soil of all this Sarái region is excessively sandy and

ill-fitted, unless well irrigated for agricultural purposes, it follows that the whole country is continually and unavoidably being subjected to one or other of the above processes of deforestation, and that high timber is in consequence an impossibility.

Of course there are places where the forest has to some extent escaped this wholesale conversion, first into ashes and then into small coppice cover. From such areas it has been found practicable to supply different Railway Companies with several lakhs of sleepers, to the great advantage of certain contractors; but these spots are few and far between, and now contain only a remnant of big trees, a large proportion of which have been ruined for timber purposes by the practice of *rál* tapping.

Perhaps the best way to describe the forests of Rewah would be to give a short account of the most valuable areas, and to ask the reader mentally to fill up all the intervening country with small cultivated valleys and wooded undulating ground and hills, the former covered with Sarái and bamboo coppice, the latter with the deciduous forest common to Central India.

The chief tracts deserving notice are—

The Sôn.
The Majholi.
The Bandogarh.
The Sohagpur.
The Lac.

A beautiful river is the Sôn in Berdi when seen on a bright sharp morning in December. Its broad expanse slowly disengaging itself from the misty wreaths of night lies reveals a perfect delight to the visitor from ugly sandy Satna. Its banks wooded to the edge with dark green Jamun or the graceful Kawah, (*Terminalia Arjuna*,) or rendered bright with a vivid patch of early wheat form a fitting border for the shining river; and as one floats or paddles down its rather sluggish but brilliantly clear stream, catching a glimpse of Rohú and Mahseer as they leap from their crystal home, or disturbing a flock of grey log Geese or wily Pintail, a sense of pleasure and exhilaration is experienced, much as when the burnt-up plains-man first catches sight of the distant snows, and feels the life-giving breezes from the hills.

In the neighbourhood of the southern bank of this river, and in the last 25 miles of its course through the State, there is an area of 150 square miles of hill forest partly intermixed with cultivation, which, owing to its proximity to the Sôn, is, or rather will be, if protected, a valuable forest property. Nowhere containing large timber of valuable quality except Mowha (*B. latifolia*) and Pursid (*H. binata*), this forest would yield a very large quantity of second class timber of dimensions varying from 1 to 3 feet girth. On the higher hills the good growth consists principally of *A. latifolia*, *A. Catechu*, *L. parviflora*, *T. tomentosa*, *D. Ebenum*, *O. dalbergioides*, *B. latifolia*, and *H.*

binata, of which the two first named species are much the most plentiful. Of inferior woods *B. thurifera*, *Z. xylocarpa*, *E. officinalis* are abundant, and bamboos in greater or less quantity, are present nearly everywhere. On the lower hills, and on the uncultivated undulating country, the above species are all found mixed with *B. frondosa*, *S. robusta*, *Carissa karandas*, and *Z. Jujuba*, and on the rivers and streams *T. glabra*. *U. integrifolia* and *B. malabaricum* are well represented. I have measured trees of this last over 60 feet in girth round the buttresses 5 feet from the ground.

Sarái is nowhere of large size, seldom over 2 feet in girth; it clings to the small hills and valleys, which are naturally the first situations brought under cultivation; it is cut down everywhere to make *dhya* fields, or to supply ashes for the better class lands; and when by chance it has spread upwards into places difficult of cultivation, it has been girdled for the extraction of its *rál* or resin. This is the only forest in Rewah where *H. binata* is found. It keeps to the neighbourhood of the river, and as far as my experience goes is not conspicuous even in the Sôn forests west of the Gopat. It increases eastwards from the junction of this river with the Sôn, and near the border of the State is fairly plentiful and of girth up to 5 feet. Further south in Singrouli, or rather that part of Singrouli in the Rewah State, I have not come across it. Dr. Brandis mentions it as present in the Singrouli hills, but he probably alludes to British Singrouli.

A commencement has been made to work this forest by exporting its small wood and bamboos for sale in some of the chief towns of the lower Gangetic valley. Large rafts are constructed in February-March, and floated down the Sôn to Dehrighát, a distance of 190 miles, at which place the wood is sold to traders coming from Buxár, Arrah and Dinapore. The prices obtained are very moderate. Bamboos fetch only Rs. 9 a thousand, and poles from Rs. 16 to 25 a hundred, according to girth. Competition is also very great, and the Rewah forests being higher up the river, and therefore further from the markets than any other, are badly situated for trading purposes. But the private forests lower down in British territory are said to be rapidly deteriorating, and if so, the day is not far distant when Rewah produce will be able to compete on better terms than at present. Even now our experiments, in spite of two serious accidents by flood and fire, have yielded a profit of 75 per cent. This area is one of those selected by the forest officer for a reserve, but it is not free from private rights, which are difficult to reconcile with State interests, and its demarcation will be delayed until these can be settled.

J. M.

(*To be continued.*)

TAPPING *PINUS LONGIFOLIA* FOR RESIN.

As there is some likelihood of a considerable demand arising almost immediately for *Pinus longifolia* resin, the subject of tapping that tree ought to possess no slight interest for the Himalayan forester.

The extensive forests of this pine which stretch along the lower slopes of the outer North-West and Punjab Himalayas have hitherto remained valueless except at a few points, such as Naini Tal, Ranikhet, &c., where the wants of a large local population and the absence or insufficiency of other woods have raised this pine to the position of the chief or sole timber and fuel tree. Not that there is no market for its timber in the numerous wealthy towns situated within a hundred miles of the hills, but present prices are as yet too low, and transport too difficult and costly to make export from those hills pay. Hence every circumstance likely to increase the value of the pine ought to be very welcome. Should the tapping of the tree for resin prove remunerative, the result may be that we shall be able to work several hundred square miles of well-stocked, hitherto unproductive forests, for the conservation of which other forests have at present to pay, and which hence make our financial position appear year after year much worse than it really is, and act as a drag on the progress of the Department.

There is on the surface no reason why the *Pinus longifolia* should not be as important a source of wealth to Northern India as the cluster pine is already to the West of France, even with its present very imperfect means of communication. As in both trees the largest quantity of resin is contained in the sapwood, it is probable that the method employed in tapping the one will suit with little or no modification the other. Readers of the "Indian Forester" will hence perhaps find the following extract from the Translation of BAGNERIS' *Elements of Sylviculture* interesting. It describes the method employed in tapping the cluster pine, and gives some information regarding the amount of yield and price of the resin and its manufacture into the various products used in the arts. The excellent illustrations which accompany are from the pen of Mr. A. F. Broun, who has kindly drawn them at my request for the "Indian Forester."

"There are two methods of resin-tapping, which in French are termed respectively *gemmage à mort* and *gemmage à vie*. The first exhausts and kills the tree (whence the name), and is adopted only when the tree is to be felled soon after; the second, as may be guessed, has for its object to obtain the resin without causing the death of the tree. In either case, the first thing to be done is to take off gradually a rectangular strip of bark, beginning at the *foot of the tree* and going up about 4 inches; a little wood must also be removed with the bark. The wound thus made is technically called a *quarre* or blaze. The instrument used is a light axe with a curved head and a handle bent at an angle in the direction of the concave face of the

TAPPING PINUS LONGIFOLIA FOR RESIN.

FIG. 1.

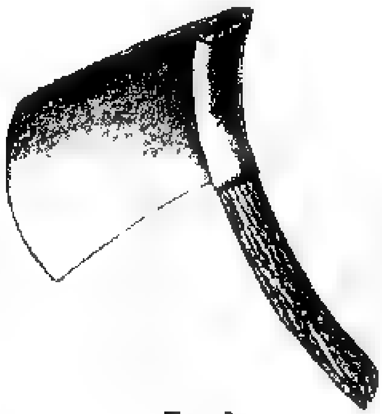
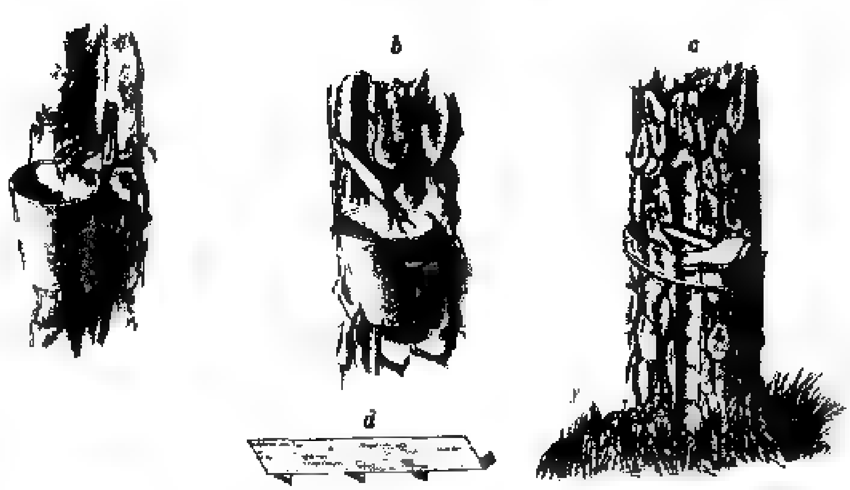
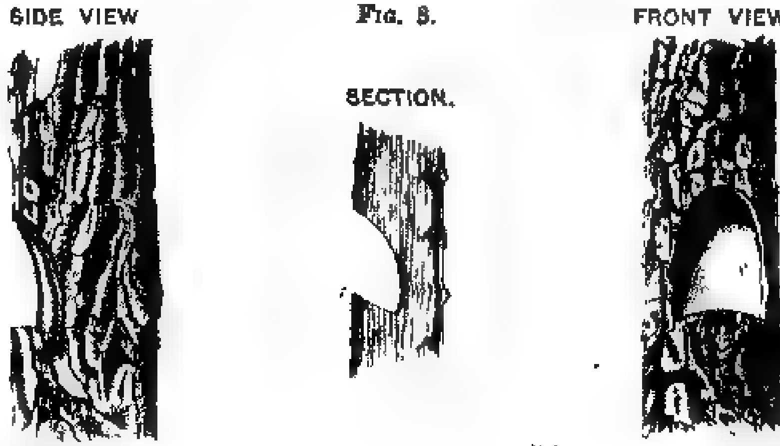


FIG. 2.



SIDE VIEW. FIG. 3. FRONT VIEW.



Litho. T. C. Press, Roorkee. THOS. D. ROSE, Supdt.

head (see *Fig.* 1). Once or twice a week the wound is re-opened, and it is at the same time lengthened by taking off a fresh strip of bark and wood above it about two-fifths of an inch long. In this manner the wound attains a certain length, which in the forests under the control of the Forest Department ought never to exceed 11 feet. Moreover, in the printed stipulations which contractors bind themselves to observe when they purchase the right of resin-tapping, there is a clause which fixes a maximum of 5 inches for the breadth of the *quarre*, and a maximum of two-fifths of an inch for its depth.

"Only one *quarre* at a time ought to be worked in those trees which are not to be felled in the next thinning operations. To prolong their existence, it would even be desirable to make the *quarre* only 3 inches wide. The same *quarre* is worked for 5 years by the process explained above of freshening and lengthening the wound. During the first year it is lengthened by 22 inches; during each of the three succeeding years by 26 inches, and during the fifth year by 28 inches. At the end of this term a new *quarre* is opened, which is worked in the same manner. This process is repeated until within a few years of the felling of the trees so tapped, when the process called *gemmage à mort* is employed.

"No tree is tapped in the manner we have just described before it has attained a circumference of 3 feet. M. Lamarque is of opinion that it would be better at the beginning to work a *quarre* for only four years, and then give the tree rest for one year. The *quarres* when left alone, soon heal up by the formation of new rings of wood and bark, and some time after a new *quarre* may be opened in the swelling formed by the bark immediately over the old *quarre*.

"The swelling is a sure indication of the existence of an old *quarre* beneath, and some old trees may be seen here and there bearing traces of several of them. It frequently happens that from want of sufficient adherence, the bark separates on each side of the old wounds, the separation being wider at the middle, where also the consequent swelling out of the bark is naturally greater. This phenomenon gives the lower part of the stem the shape of a spindle, and the trunk looks as if it was being crushed under the weight of the portion of the tree above.

"In private forests the *quarres* are often allowed to reach a height of 13 to 16 feet, and two or three are worked at a time on thick trees. This is a bad practice. If for the time being a tree is made to yield a large quantity of resin, its longevity is materially shortened.

"As we have already indicated, *gemmage à mort* is practised only in the case of trees near their maturity, or of those which are to be felled in the very next thinning operations. It is begun as soon as the trees are big enough to contain a *quarre*, in other words as soon as they have attained a girth of 20 to 24 inches. This generally happens at the age of 20 years. The *quarres* are opened in precisely the same manner as in the first process; only they are worked up faster, and several at a time are opened in each tree. Usually a tree treated thus dies in three or four years.

"When a new *quarre* is cut or an old one re-opened, the resin oozes out in bead-like drops. A portion of it flows down the wound; the rest, owing to volatilisation, solidifies and forms a crust over the

exposed wood. This solid substance is known under the name of galipot. Formerly the resin was allowed to run down to the foot of the tree, where it was received in a little trough hollowed out in one of the roots or in the sand. Much of the resin was thus lost by absorption in the sand, especially in the first year. Little earthenware pots are now used, which are hung along the stem of the tree, and are raised as the *quarre* is worked up higher (see *Fig.* 2). To get the resin to flow into the pots, a small curved plate of zinc (see *Fig.* 2*a*) is lightly driven in an oblique direction into the wood immediately over each pot.* The pot is kept in its place by means of a nail fixed under, and on which it rests lightly. To render the waste still smaller, the pot is covered with a thin board, which prevents the loss of the volatile portion of the resin (*Fig.* 2*c*). The resin-tapper examines the pots when he goes round to re-open the wounds, and empties any he finds full. The *galipot* is scraped off once or twice a year.

"The use of these pots and plates of zinc constitutes the method of Mr. Hughes. It requires a heavy outlay at first, but it possesses the advantage of yielding a larger quantity of resin, and that in a purer state. According to Mr. Samanos the results of this method as compared with former results are as four to three. It is much employed in the Dunes at Cape Breton, Mimizan, Biscarosse and la Teste. But in the district round Dax its use is not so general, while at Mont de Marsan it is still rare. This is a source of much loss. To diminish the waste of resin by absorption in the soil, the tapper makes the same trough serve for several successive *quarres*. They are consequently obliged to cut little canals all round the foot of the tree leading one and all into the same trough. These canals are necessarily cut right into the wood, and thus soon kill the tree.

"Resin-tapping is carried on only in the interval between the 1st March and the 15th October; but the gradual thinning off of the bark is begun as early as the 10th February.

"Resin is most abundant in trees which measure at least 16 inches in diameter. A pine of this size yields annually three litres by the process of *gemmage à vie*. Taking into consideration the continual diminution in number of the trees, we may reckon that an acre yields annually about 30 gallons, whatever be the age of the forest. *It is not so easy to calculate the yield by the process of gemmage à mort.* Still it is generally admitted that from 80 to a 100 pines 8 inches in diameter will also yield annually the same quantity, and that for three years. On the estate of M. Marcellus, near Biscarosse, I saw a pine 13 feet in girth and 36 feet high up to the first branch, which had ten *quarres* worked on it simultaneously, and which still yields seven or eight litres of resin annually.

"The price of the raw resin is necessarily very variable. Sometimes it is as low as 40 francs a *barrique* (340 litres). During the American war it rose to 290 francs. At Mont de Marsan, where it is converted into the different manufactured resin products of commerce, the actual price of a *barrique* is 120 francs.

* A much simpler and more effective plan is now followed. A flat plate of zinc (*Fig* 2*d*) with one corner slightly curved upwards is driven in obliquely across the *quarre*, the curved corner being immediately over the pot which is hung on one side of the *quarre* (*Fig.* 2*b* and *e*).

"The resin-tapper is paid so much per *barrique*, usually from 30 to 35 francs; which gives an average of four or five francs a day.

"I visited at Mont de Marsan several distilleries. In one of them they distil the resin for spirits of turpentine. The raw resin always contains, according to the care with which it has been collected, a greater or less quantity of impurities, such as lumps of earth, chips of wood and bark, leaves, &c. To remove these the resin is put into boilers in which it is subjected to a temperature just high enough to liquefy it without causing it to volatilise. In this liquid state it is passed through sieves of rye-straw into troughs. The clear liquid is known under the name of *térébenthine*.

"From the troughs the *térébenthine* is conducted through a pipe supplied with a stop-cock into a still. During the distillation, a thin continuous stream of water is introduced into the retort by means of a funnel. The water, in the state of steam, carries over with it the spirits of turpentine, and after condensation in the worm they are both received into a vat.

"They are then separated by the process of decantation. Colophony and black and white rosin are made from what remains in the retort. A conduit-pipe leads this residue into a trough, whence it is passed through a very fine brass sieve into a wooden chest; what is collected in the chest is colophony, what is left behind in the sieve is black rosin. It is made into cakes of from 100 to 200 lbs., by pouring it while liquid into troughs hollowed out in fine sand. White rosin is prepared in the same way, except that the hot residue in the sieve is agitated briskly in one-tenth its volume of water before it is poured out into the sand moulds.

"All these products have their special industrial uses. Spirits of turpentine are employed in medicine, in the preparation of varnishes and paints, for lighting, for cleaning furniture, &c. The solid products enter into the manufacture of paper, soap, stearine candles, torches, sealing-wax, &c., and are also used for the caulking of vessels.

"The residue from the first filtration of the crude resin is burnt in special stoves, and yields tar and pitch.

"One *barrique* of crude resin gives 100 kilos. of spirits of turpentine, which, taking actual prices, would be worth about 125 francs; the other products cover all expenses and yield besides a trifling profit. Black rosin sells at the rate of 18 francs per hundred kilogrammes; the price of the same weight of white rosin is 20 francs.

"In another establishment in the same town, the black rosin is heated to a high temperature, by which a double decomposition takes place. The result is, according to the manipulations employed, the separation of certain volatile oils used in varnishes, or of certain fixed oils which are used for lighting, for impregnating wood, in making wheel-grease, in the manufacture of printing-ink, &c."

In the Himalayas the *Pinus longifolia* is already tapped on a small scale, the crude resin being sold in the bazars under the name of *biroza*, *ganda phiroza*, *dhup*, *berja*, *lisa*, *khalja*, *&c.* A small quantity of turpentine is also distilled therefrom for sale in the neighbouring towns. This industry was carried on more extensively before the conservation of the Government forests, since

which time the tapping of the pine therein has been strictly forbidden. This is a measure much to be regretted. No doubt the extremely primitive and fatal method of tapping is responsible for the crippling of that very useful industry, but nothing was easier than for the Forest officers to teach the hill-men improved methods.

The present system employed in the hills of Kumaun and Garhwal is to cut a sort of niche in the stems of the trees from 3 to 4 feet from the ground (see *Fig.* 3). The bottom of the niche is hollowed out into a shallow trough to receive the resin as it oozes out. The trough is cleared out as often as it fills, sometimes as soon as the second or third day, but usually between the fourth and tenth day, when the niche is first made, and at longer intervals afterwards. Generally the resin-tapper does nothing more to the niche once it is made, but, as the resin volatilises and hardens over the wound into a crust which impedes the flow of fresh resin, he sometimes chips off the wood on the sides so as to get rid of this crust. The same niche is used for two and even three consecutive years when no forest fire occurs, which either burns down the tree or chars the resin-encrusted wood of the niche to a depth of an inch or more.

Tapping begins in February and ends in May or June, *i.e.*, during the period of comparative vegetative repose. As soon as the buds expand and the tufts of new leaves are developed, the outflow of resin either ceases or becomes too insignificant to be collected. The higher the temperature and drier the weather is, the more copious is the exudation of resin.

As regards the yield per tree, the quantity is very variable according to the size and vigour of the tree, the state of the season, the nature and condition of the soil, and the number of niches cut. As the hill-men never concern themselves about the life of the trees they tap, they work several niches simultaneously, the result being either death by exhaustion or the breaking of the tree by the wind helped by forest fires—a veritable *gemmage à mort*.* Mr. Richard Thompson (Brandis' "Forest Flora," page 507) says that "the yield of an ordinary sized tree is 10 to 20 lbs. of *berja* for the first, and about a third of the quantity the second year," in other words, from 13 to 27 lbs. My own information collected in Garhwal and Kumaun gives the yield of a single niche—4 to 6 lbs. the first year, and rather less than a half of that the second year, or from about 6 to 8½ lbs. in all. As a small tree would contain two and a large one three niches, these figures agree pretty nearly with Mr. Thompson's. The

* The vitality of *Pinus longifolia* is, however, so extraordinary, that in forests from which the resin-tapper has now been excluded during the last 10 years and more, thousands of trees may be seen containing old charred niches. The bark may be stripped off over a breadth of 4 or 5 feet all round the trunk, without necessarily killing the tree.

largest outflow takes place when the niches are just cut, as much as 1 lb. being sometimes obtained from a single niche from an average sized tree.

If we adopt the system of the French Landes, with the slight modifications, if any, it will require, we shall probably obtain by the method of *gemmage à vie* about the same quantity annually that is now taken out of a single niche during the first year. In other words, there is every reason to expect that the yield per tree in our *Pinus longifolia* forests will be little, if at all, inferior to the yield per tree in the cluster pine forests of the Landes. And we have in our favour cheap labour: the Landes resin-tapper earns from Rs. 1-14 to Rs. 2-6 per day, his Indian pahari brother will think himself lucky if he is paid 8 annas a day.

Last year at Naini Tal Mr. Braidwood very kindly supplied me with some crude *Pinus longifolia* resin, from which I distilled essential oil of turpentine, the residue being a pale straw-coloured colophony. The resin was full of impurities (about 5 per cent.) From 3½ gallons I obtained 3 quarts of oil, and about 20 lbs. of colophony. I lost a good deal of the resin in clearing it through a sieve, and the worm of my still leaked very considerably. We shall probably not be far wrong if we assume that the yield of oil under favorable circumstances would be about 30 per cent. of the crude resin, or about the same as in the case of the cluster pine.

Some of the essential oil I distilled was submitted by Mr. Greig, the Conservator, to Mr. Morrison, Pharmaceutical Chemist at Naini Tal, for professional opinion. I have not seen Mr. Morrison's written report, but he told me in conversation that he had subjected the oil to the prescribed tests and had found it, as regards medicinal purposes, equal to the best imported oil, except that its odour was much less pungent. For industrial purposes it will probably be found to be quite as good.

A proposal has recently been made to use the crude resin for the manufacture of lighting gas, and if the necessary quantity is forthcoming a trial is to be at once made. Whatever this idea may ultimately come to, some experiments ought certainly to be undertaken in tapping the pine, and manufacturing from the crude resin the various commercial products it can yield. What locality could be more favorable for the purpose than the hill-forests of the School Circle of the N.-W. Provinces? Success, which is assured if the experiments are properly carried out, will result in every *Pinus longifolia* tree, which is now practically valueless, yielding 8 annas yearly, and every moderately well stocked acre Rs. 15 per annum!

E. E. FERNANDEZ.

THE BOUGAINVILLEA.

This magnificent climber is now common in many parts of India, and as it can be obtained without any difficulty from any public gardens, no garden, however small, should be considered complete without it. In some of our large public gardens it has been so extensively planted that it completely overshadows everything else, and after a casual visit, one is apt to leave with the impression that it contained little besides the *Bougainvillea.* I strongly advise owners of small gardens to guard against this mistake. A few plants judiciously disposed, will produce a much better effect than when large numbers are employed.

There are several species and varieties, all natives of tropical South America. The most of them have been introduced into this country, but only two of them are as yet common. *Bougainvillea glabra,* a species with stiff straight spines, and bright shining leaves is the one most frequently met with, and as it is the only one that flowers all the year round, it may be considered to be the best. As is well known, the flowers of the *Bougainvillea* are small and inconspicuous, and their whole beauty lies in the coloured leafy bracts surrounding the flowers. Those of *B. glabra* are of a bright mauve, faintly tinted with pink, and are produced all the year round, but in greatest profusion during the cold season. An inferior and almost spineless variety of *B. glabra,* with pale pink bracts is sometimes met with. It is a handsome object when covered with its delicate looking bracts, but as it only produces them during the months of February and March, it is greatly inferior to the more common variety which flowers all the year round. *Bougainvillea spectabilis* is the other species frequently met with, and is easily distinguished from *B. glabra* by its formidable hooked spines and rough hairy shoots and leaves. Its bracts are somewhat larger than those of *B. glabra,* and are of a purplish mauve. They are only produced during the months of February and March, and although of a more pleasing colour than those of *B. glabra,* it is not to be compared with the latter for general usefulness. *Bougainvillea speciosa* is one of the uncommon species we possess. Its bracts are of even a deeper mauve than those of *B. spectabilis,* and when more abundant and better known, it will no doubt prove a favourite variety. It flowers during the greater part of the cold season, and may be placed next to *B. glabra* for general excellence. A species named *B. lateritia* has been lately introduced. Its leaves are slightly hairy, and the bracts of a bright brick red. It is a very distinct species and, as it flowers profusely from September until the following April, it is well worthy of a place in every garden.

The *Bougainvilleas* fortunately flourish in this country with little care and attention. They will grow in almost any soil, but attain greatest perfection in a light, rich, and open loam.

They appear to greatest advantage when planted beside a large open branched tree, and allowed to ramble over it at will. When this situation can be given, it should always be used in preference to any other. It also looks very well trained up against a wall, or when grown on a bushy shrub in the centre of a grass plot or lawn. When planted beside a tree the pruning knife is seldom or ever required, but when planted in either of the two last named situations, it may be used with advantage. Circumstances often require them to be kept within due bounds, and as the use of the pruning knife does not in the least interfere with their flowering propensities, no one need feel any scruple in removing superfluous wood. The *Bougainvilleas* are propagated by layers made in the rains or by cuttings made from ripened wood in the cold season. Both methods answer very well for *B. glabra*, but for all the other species I have mentioned, layering is the only certain method of obtaining a stock of young plants. I have raised all the other species by cuttings, but never was able to get above fifteen per cent. of them to strike root. As far as I am aware the *Bougainvillea* never ripens seed in this country. All the flowers I ever examined seemed to be perfect, and I cannot give any satisfactory reason for its non-production.

W. G.

REDUCING FACTORS AND CANOPIED FOREST.

[We are glad to publish the following very interesting extract from a letter received from our observant correspondent KAD HANDI: but (need we say it?) we have no sympathy for the uncouth terms '*Aclon*' and '*Monlon*' suggested by him.]

Among your definitions you have not included any of the various terms in use expressive of the yearly growth of trees, individually and in masses. The expressions 'increment' and 'annual yield' are current. Of these 'yield' is vague and at best one word in a paraphrase; while 'increment' is a longish word and, as far as it goes, is precise; but, simply to be understood, we must say 'increment per acre per annum,' and 'average increment per tree per annum.' I have shortened this into 'acre-increment' and 'individual-increment' in the tables of growth of *Eucalypti* and Casuarinas, on which I have been engaged during the latter portion of Dr. Brandis' visit to South India.

I must admit that till quite recently I was not alive to the importance of the figure expressing the average individual growth. An examination of the figures of growth obtained from the Blue Gum plantation on the Nilgiris showed that there was a considerable loss of growth from overcrowding. While the acre-increment varied little within such wide limits as 100

trees per acre and 1,000 trees per acre, the individual-increment varied from only half cubic foot in the crowded plantation, to 1½ cubic foot in plantations which were more open. The acre-increment was better in the more open plantation, varying from 11 tons to 13½ tons (dry wood with bark), but it was the individual-increment which demonstrated the startling loss of growth in the over-crowded plantations. In an old plantation of 20 years, the individual-increment rose to 4 cubic feet. It is higher than this for the trees grown at the margin of a close plantation, and higher still for trees grown isolated. Colonel Beddome, in one of his reports, cites an apparently thoroughly authentic case of an "individual-increment" of 12 cubic feet in an isolated *Eucalyptus globulus*. Again, some sparse Casuarina planting in Mysore (put down by Major van Someren in 1870 and 1871) yielded the satisfactory acre-increment of 5 tons, but the individual-increment was better than I should have thought possible.

Growth in these instances, and in some others which have been discussed already in the page of the "Forester," appear to depend to a great extent on the subsoil moisture available during the hot weather: the more spare the planting, the more moisture is there available. This is, of course, speculation, but other facts point in the same direction. What is certain is that close-planting as we understand it in Europe* does not give the best figures of growth either in the case of the Nilgiri *Eucalypti* or the Mysore Casuarina. I expect that close-planting will appear to better advantage in the Madras Coast Casuarinas, though the appearance of the very close-planting which has been adopted there is disappointing. Everything in the management of the plantation depends on these two figures which I have called the *individual-increment* and the *acre-increment*, and which, if the suggestion is worth anything, I would propose to call the "MONLON" and the "ACLON."

VALUE OF INDIAN BOXWOOD IN THE LONDON MARKET.

EARLY last year two parcels of boxwood were sent from India to London for sale—one from the Jaunsár Division of the School Circle, and the other from the Ganges Division of the Central Circle, N.-W. Provinces. The latter consignment was cleaner and better than that from Jaunsár, and of more uniform diameter and length, and when sold, it fetched £5 or £6 a ton

* KAD HANDI's remark applies only to France. In Germany the distance to have between plant and plant in the case of all the most important species, so as to secure the maximum production, has been established by careful experiments carried on through a long series of years.

more than the Jaunsár wood; but it was declared to be almost worthless for engraving, being too soft and short grained, and it was probably sold to the shuttle makers, who require a certain length, and it so happened that the Ganges pieces were 3 feet 3 inches long each, which just suited them. The Jaunsár logs were of all sizes from 2 feet to 5 feet long, and up to 4½ feet girth.

The previous consignment from Jaunsár, which fetched £30 per ton, was bought on speculation for the engravers, and it cut up badly and landed them in some loss, so they naturally fought shy of the next lot.

But the price varies with the supply in the market, and Himalayan boxwood, if of uniform length and size, would generally command a remunerative price. Messrs. Churchill and Sim have entered into a contract with the officer of the Ganges Division to supply 25 tons at £25 per ton, if the quality comes up to his last consignment; so it would appear that the engravers are glad to procure Himalayan boxwood, when there is no better to be had. At that rate it should be slightly remunerative, but the expenses of bringing it out of the hills to the edge of the plains are very great, as it all has to be carried on coolies' backs.

The Persian and Turkey boxwood is of slower growth, and harder than ours, and a piece sent to the Forest School Museum weighs nearly 68 lbs. per cubic foot, as compared with 66 lbs. for Jumna boxwood, and 56 lbs. for the Jaunsár consignment mentioned above. If the wood from the upper portions of the Jumna and Bhagirathi should prove to be uniformly as high as 66 lbs. per cubic foot, then there is no reason why it should not sell as well as Turkey and Persian wood, provided the pieces are straight, of uniform character throughout, and free from knots.

For it appears that the supplies from abroad are falling off, and already engravers are beginning to foresee the necessity of inventing some substitute for boxwood in the shape of steel or other suitable material, not being wood. But, meanwhile, until that day arrives, our hill boxwood will probably be exported at a profit.

A. S.

WOOD FOR OPIUM BOXES.

The following letter from Mr. Rivett Carnac, Opium Commissioner, Ghazipur, to the Director, Forest School, Dehra Dun, on the subject of opium boxes will be interesting to our readers, and we venture to publish it together with the memo. which was drawn up in reply, in the hope that some of our readers may be able to throw light on the subject.

"*Ghazipur, 8th June, 1888.*

"We have now considerable trouble with opium packed in sál wood. Much has gone bad, *i.e.*, the shells of the cakes in these chests have rotted, or charred.

"*It* has been held by some this is the fault of the opium, by others, of the *wood*.

"Several who examined the wood declared it *unseasoned*, the planks on being split showing damp and resinous streaks in the centre, (planks ¾-inch thick).

"On the other hand the suppliers contend this is an impossibility. The ¾-inch planks had all, it is asserted, been sawn one year. One year is ample, it is held, to season thoroughly any ¾-inch plank of sál wood.

"The other side retort, that no such theory can stand in the face of wood found on examination to be as described above—12 months may *or may not do—much will depend on the state of the tree when it was* felled, the season of the year, the treatment of the sál log.

"Sál logs are valuable or not, it is said, according to the above conditions; a log may be indifferent and badly seasoned from the outset, and a 12 months' theory will not apply to such a log or its planks; much must depend on the treatment of the log after felling, and the period during which the log has undergone the seasoning process.

"Will you very kindly give me any information on the above points your experience may suggest. Can you add any information regarding the merits or demerits of sál for packing perishable vegetable substances like opium, and is there more than one standard of a seasoned sál plank? The *P. W. Officers have declared the wood to be un*seasoned, but the suppliers say the standard is too high!"

Memo. sent in reply.

"The following extract from Mr. Gamble's Book of 'Indian Timbers,' page 37, gives the best possible account of sál wood:—

"'It is from Mr. Clifford's Memorandum on the Timber of Bengal.

"'The inherent qualities of sál render it a very difficult wood to season, it warps and splits in drying, and even when thoroughly seasoned, it absorbs moisture with avidity in wet weather, increasing $\frac{1}{24}$th in bulk, and *correspondingly in weight*.'

"From this extract, which admirably represents the facts of the case, it is evident, that however useful sál timber may be for purposes of construction, it is not at all a suitable wood for boxes or furniture. The presence of resin in the wood is characteristic, and must also be prejudicial to the opium; and it is also doubtful whether sál wood is ever properly seasoned except for rough work.

"As long as only heart-wood is used, and sál sap-wood is very liable to decay, and perfectly useless for purposes requiring durability, it would matter little at what period of the year the trees were felled. There is a probability, however, that logs barked and left to lie in the forest till their sap-wood has decayed, yield timber less liable to warp than wood sawn from freshly cut logs, and then seasoned in a timber yard.

"There is no doubt that dead sál wood found in the forests, provided it is not riddled with the holes of borers, and this will not be the case if the bark is stripped off immediately after the tree has been felled, is greatly prized by natives for making door and window frames, &c.

"Tún, sissú, huldú and several other woods will be found better adapted than sál for opium boxes, but of these probably only sissú wood is procurable in large quantities.

"If the price be not prohibitive, it is very likely that teak wood, which is already largely used in Assam for tea boxes, may be found most suitable."

FOREST TREES SUITABLE FOR BANGALORE.

TO THE EDITOR OF THE "INDIAN FORESTER."

SIR,—Will you or any of your correspondents be so good as to inform me what forest trees would grow on dry stony soil and red loam, in open country in a climate such as Bangalore, 3,200 feet above the level of the sea, with a percentage of 30 to 35 inches of rain per annum; and is it advisable to top off the under branches of a sapling? Will this in any way improve the trunk or growth of the plant? Will such trees as *Terminalia chebula*, *Rottlera tinctoria*, *Sapindus emarginatus*, &c., thrive in the above-mentioned soil?

Should a plant not grow to any size (say 4 feet high) in 7 years, is there any hopes of such a plant making any progress? Will you also be so good as to inform me where I can obtain a quantity of sál seeds for planting, as Dr. Brandis mentions in the May Number of the "Indian Forester" that sál takes to sand, stone and gravel.

DENKANICOTTA, SALEM, *2nd July, 1883.* TOPES.

NOTE BY EDITOR.—We hope some of our readers in Southern India will *furnish the required information.* There is a difficulty in transporting sál seeds, which frequently germinate before they fall, but we have sent some to Mr. O'Neill, and hope that he will inform us whether or not they prove successful. A small basketful was sent in 1877 from the Bori forests in the Central Provinces, to Major van Someren, then Conservator of Forests in Mysore. As far as we recollect, the seeds had all lost their germinative power by the time they reached Bangalore.

III. Notes, Queries and Extracts.

East Indian Furniture Woods.—Toon Wood (*Cedrela Toona*) is light, soft, and red, and has no heartwood. It is not eaten by white ants; it is highly valued and universally used for furniture of all kinds, and is also employed for door panels and carving. From Burmah it is exported under the name of "Moulmein Cedar," and as such is known in the English market. It there fetches about Rs. 65 per ton, the cost of cutting and delivery being Rs. 44, according to Major Seaton. In North-West India it is used for furniture, carvings, and other purposes. In Bengal and Assam it is the chief wood for making tea-boxes, but is getting scarce on account of the heavy demand. The Bhutias use it for shingles and for wood carving; they also hollow it out for rice pounders. It is, or rather used to be—for very large trees are now rather scarce—hollowed out for dugout canoes in Bengal and Assam. In Bengal, Assam, and Burmah it grows to a very large size, trees 20 feet girth, with a height of 80 to 100 feet of clear stem, being not uncommon in forests which have been only little worked like those in Dumsong and in some parts of the Chittagong Hill Tracts.

Chickerasi or Chikrassi Wood (*Chikrassia tabularis*) is a large tree, with bark reddish brown and deeply cracked. The heartwood hard, varying from yellowish brown to reddish brown, with a beautiful satin lustre; seasons and works well, and is used for furniture and carving.

Nagesar Wood (*Mesua ferrea*) has dark red heartwood, extremely hard. It has been found to answer for sleepers equally well with Pynkado, but the cost of cutting the hard wood, its weight, and the freight from the Tenasserim forests to Calcutta prevent its being much used, as the total cost is scarcely covered by the price (Rs. 5) per broad gauge sleeper. It is used for building, for bridges, gunstocks, and tool handles; but its more general use is prevented by its great hardness, weight, and the difficulty of working it.

Pitraj Wood (*Amoora Rohituka?*) is reddish, hard, close and even-grained, but is little used. In Chittagong, canoes are sometimes made of it.

Kandeb Wood (*Calophyllum polyanthum*) is light red, shining, cross-grained, and moderately hard. It is used largely in Chittagong for masts, spars and rafters, and sometimes for small boat-building and canoes.—*Gamble's Manual of Indian Timbers.*

TAL WOOD (*Dichopsis polyantha*) is red and hard, and is much valued in Cachar and Chittagong. Mann says it does not float; but he must refer to green-wood. Major Lewin says it is used in Chittagong for making beds, tools, &c., and is sawn in boards for the Calcutta market.—*Timber Trades Journal.*

There are large tracts of virgin Nagesar forests in the Garo Hills and other parts of Assam, and if the Assam Government would imitate that of the N.-W. Provinces in spending money liberally on roads and timber slides, this large field for enterprize might be opened out. The Mechis are most patient and experienced wood cutters, and nothing is wanting, but proper means of export; and now that the demand for railway sleepers for the projected North-Eastern Frontier Railways is assured, it seems a pity that they should be dependent on Europe for their sleepers, whilst such vast natural resources are close at hand.

Some Tún logs have lately been sent from Dehra Dún to London, to Messrs. Churchill & Sims, and realized in a sale by public auction 4½*d*. per superficial foot.

Messrs. Churchill & Sims report that Tún resembles West India Cedar, but is too hard to be used for the ordinary purposes for which the latter wood is imported, namely cigar boxes and cabinet work.

Regarding a previous consignment of Tún however, the same firm reported that it would prove saleable as a substitute for Mahogany, if sent in well squared (*hewn* not sawn) logs, about 15 inches square and 12 feet and upwards in length, and would command 2*s*. 6*d*. to 3*s*. per cubic foot. The price lately obtained, £18 16*s*. 6*d*., for 112½ cubic feet, was nearly 3*s*. 8*d*. per cubic foot, but this is accounted for by the present scarcity of West Indian Cedar in the London market.

If Tún wood can be delivered in any large quantity at Chittagong or at any Burmese port, it might be profitable to send some trial shipments to London, though of course export from the forests of Northern India is out of the question, both on account of the scarcity of the timber and local demand for it, and also owing to the prohibitive charges for transport by rail to the seaports.

REFERRING to the great difficulties attendant upon bringing mahogany from the Mexican forests, a writer remarks:—"The natives are a mixture of Spanish and Indian, with an occasional infusion of negro blood, and are lazy, deceitful, and treacherous, the men doing but little, and leaving the timber cutting to the women."—*Timber Trades Journal.*

Considering the superiority of mahogany to all indigenous Indian furniture woods, and the high price, averaging 7*d*. per superficial foot it fetches in the London market, and its grow-

ing scarcity in its native country, it is strange that we have heard of no proposals to plant it out on a large scale in some of the eastern districts of Bengal, where it is reported to grow vigorously; doubtless something has been done, *vide* Gamble's "Indian Timbers," page 74, but by this time matters ought surely to have gone beyond the experimental stage.

Mr. Gamble states that the price obtained in Calcutta for the wood of a number of mahogany trees about 70 years' old, and blown down in the cyclone of 1864, was Rs. 3-6 per cubic foot. —[Ed.]

Rosewood.—Rosewood was once, says the *Builder*, a fashionable wood. It was used for costly furniture and pianofortes. There is no information respecting its first employment; but it appears certain that it became known soon after the discovery of South America. The wood from several species of Dalbergia is met with only in South America. It seldom attains a diameter of more than 8 inches, and is cut into veneers to be used as a bordering in inlaid work or for floors. But the best quality and finest descriptions are exported from Rio de Janeiro. The Rio de Janeiro wood grows to a good size, and has beautiful veins. Rosewood is sold by weight; but formerly by trunks. Rosewood is, if properly worked, the most durable of wood, may after a hundred years' use be polished again like new, is extremely hard and strong, and becomes harder with age.—*Timber Trades Journal.*

THE
INDIAN FORESTER.

Vol. IX.] September, 1883. [No. 9.

TRANSLATION OF M. PUTON'S AMÉNAGEMENT DES FORÊTS.

PART IV.

Determination of the capability of a Forest.

Definitions.—We have used the term *capability* to denote the quantity of produce which can be taken annually from a given area, managed under certain conditions, without allowing it to deteriorate, or in other words without altering its character.

Land has no *abstract* or *absolute* capability: the latter always depends on the method of exploitation to which the land is subjected. Very different results will follow according to the degree of cultivation which may be applied. In a farm annually yielding so many bushels of wheat, and so many fat oxen, the produce will be at once diminished, if the farmer sell the straw and the manure, or if he modify the system of management which experience has shown to be most productive. In a high forest, yielding under a good system 2 to 2½ cubic metres of wood per acre, if we gradually reduce the rotation, we shall see the annual produce diminish to the lowest limits of bushes, and grassy or barren plains.

In sylviculture, as in agriculture, the capability depends on the method of exploitation in the economic sense which has been given to this word in our first Chapter, and the only remaining question is to determine the capability with reference to any proposed method of exploitation.

We hope that our readers will excuse a second reference to the definition of capability, in order to clear up any ambiguity arising from the use of terms which are also employed in common parlance.

1. The capability should be *annual*, because the earth yields its fruits annually, and human wants are subject to the same law. From this it does not follow that the capability should be harvested annually; this may be done annually, biennially, triennially, &c.

2. The quantity of annual produce must be always the same, and for an indefinite term of years. This condition, inseparable from the idea of capability, may be expressed by the phrases sustained production, and constant annual yield.

Sustained production is then the condition that a figure assigned for the annual produce of a landed estate, exploited under certain conditions, may really be its capability. In ordinary language, the words "revenue, crop, produce, rent, production, yield," are often used indiscriminately, and with different meanings according to circumstances. In legal as well as in forest technicology, *yield*, *produce* are terms applied in a general way to the fruits of a landed property; whilst the terms *revenue*, *crop*, *production* correspond to the capability, as we have defined it, with the condition of being constant and annual.

*The word rent can only be used when we compare the pro*duce with the involved capital. This is the relation, the ratio between the involved capital and the revenue. It is measured by a simple figure, the rate of interest, which is the revenue of one hundred units of capital.

Statement of the Problem.—When a proprietor wishes to frame a working-scheme for his forest, the first enquiry will naturally be regarding the object for which the forest is to be maintained. One forest owner wishes to produce railway sleepers, for which wood of 15½ inches in diameter will be *required. Another wishes to limit the produce of his forests* to props for mines, and telegraph posts, for which trees of 8 inches in diameter will suffice. Another, the State for instance, wishes to produce timber of the largest dimensions which the predominant species of the forest is capable of yielding. It has been ascertained, that trees attain diameters of 15½ inches and 8 inches at the age of 130 and of 50 years; and that timber of the largest size is obtained in the locality at 180 years. 130, 50, 180 years will then be the chosen rotations, the terms of exploitability, which will give the proper character to the exploi*tation of the forest considering the end in view.*

If the forest is stocked in such a manner, as to adapt itself to the object in view, *i. e.*, if the different standing crops are properly graduated in volume, density and age, without interruption, the capability will be readily determined by the methods of aménagement which we have already explained. But the case in question rarely occurs, more frequently the proprietor is obliged to raise or reduce the number of years of the rotation, and to modify the object of the exploitation.

The annual yield, as it has been determined in the working-scheme, *will gradually improve, if at first the forest* be insufficiently stocked; if, however, it be overstocked, the annual yield will gradually diminish. To fix an age for the exploitation of a given forest, and at the same time to seek to determine its capability as a constant quantity, is then an insoluble problem;

and is only soluble in the single and exceptional case when the standing crop coincides exactly with the age fixed for exploitation.

Framers of working plans will, therefore, recognize this, and the different systems we have expounded will only ensure a steady annual yield after the lapse of a certain period of time. When we convert a coppice into a high forest, we know very well that after the transformation, the capability will be more than thrice that of the forest during the period of conversion. We must, therefore, be satisfied with fixing the capability for one period only, when we unite the compartments of the forest into periodic blocks, in order that, in the future, the annual yield may, in the fullest manner possible, satisfy the condition of being steady and sustained.

Such therefore is the limited scope of the methods for determining the capability, when we are framing a working plan, for a special object; and we can only satisfy the condition of a steady annual yield to the extent of ascertaining the capability for one period under all possible conditions, with the future hope of rendering it constant, as long as the object held in view by the *aménagiste* is adhered to.

But very often, and as long as the object of the working-scheme has not been attained, this condition of a steady annual yield may remain unsatisfied throughout several periods. Occasionally, in the case of State or Communal forests for instance, it is more convenient for the proprietor to put off the realization of a portion of the production which the working scheme yields, or to realize it more rapidly, as in the case of most private owners. A forest proprietor cannot at once increase the yield of a poorly stocked forest, as a farmer can do in the case of an overworked farm, by buying manure, and increasing the number of his cattle. For the former, only cash is wanting, whilst for the forester, economy and a sufficient lapse of time are absolutely necessary.

The problem of determining the capability for *a given time* in a forest worked with *a certain object in view*, has therefore been disposed of in the preceding chapters; it is only one of the questions of the working-scheme, and not by any means the most important of them, and we need not go back to it again.

The problem which we will now consider is as follows:—

Given a certain forest, to determine its capability, i.e., the quantity of produce it can yield annually and steadily, without deteriorating.

Has this question any practical utility, or is it only a purely theoretic and speculative idea?

It is a sufficient reply, to point out the cases where the law (of France) makes it one of the conditions of possession of a property.

A forest right-holder can only claim the capability of the estate subjected to his right, and the proprietor can always reduce his claim in accordance with the actual state and capability of the forest, (Code Forestier, Art. 65, 112 and 121.)

Communities can always demand from the forest administration the complete capability of their forest property, but nothing more, (Code Forestier, Art. 112.)

In cases of dispute, the capability of the forest is determined by the Civil or Administrative Courts, (Code Forestier, Art. 65 and 120.)

The right-holder obliged by the Civil Code (Art. 578) to respect the substance of the immoveable property subject to his right, must limit his demand to the capability of the forest, as we have defined it.

But many other cases resemble that of a right-holder, rights by marriage settlement, rights of parents over the property of their children, &c., such are some of the cases which may occur. It is, therefore, very important to explain what procedure should be adopted to dispose of an adverse claim, either by a friendly compromise, or in the civil courts.

The different working-schemes which we have explained, contain implicitly the solution of this problem.

We will, however, at once except forests managed under the selection system. What we have said before on page 384, regarding the capability of selection forests, shows clearly enough, that it is impracticable to determine this in any satisfactory manner. Valuations by experts, comparisons with neighbouring forests, can be made, but that is all. The choice of the capability will entirely depend on the experience and skill of the forester entrusted with its selection.

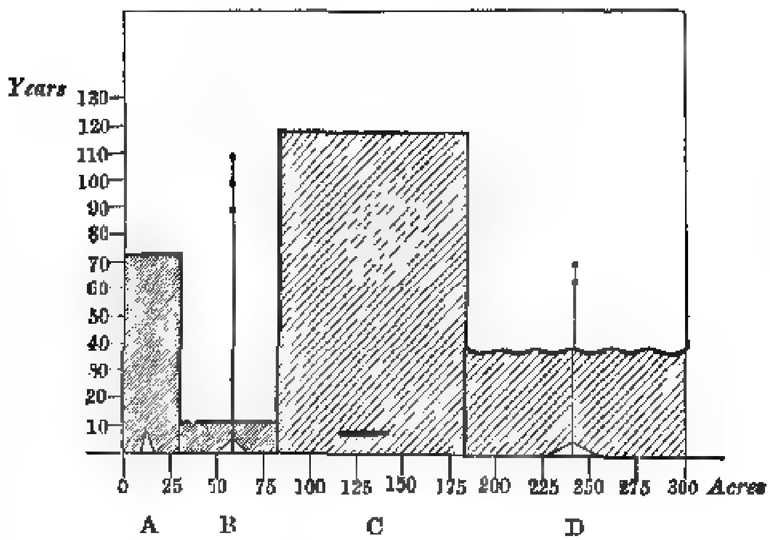
It is only in coppices, and in regular high forest, that the solution of the question is possible, and even then only in a certain degree, and all that can be said is, that it may possibly be solved in a practical manner.

The following method may be adopted : suppose that a forest of 300 acres forms the marriage portion of a bride, and that the husband wishes to determine its capability, in order to arrive at a proper estimate of his and his wife's common property.

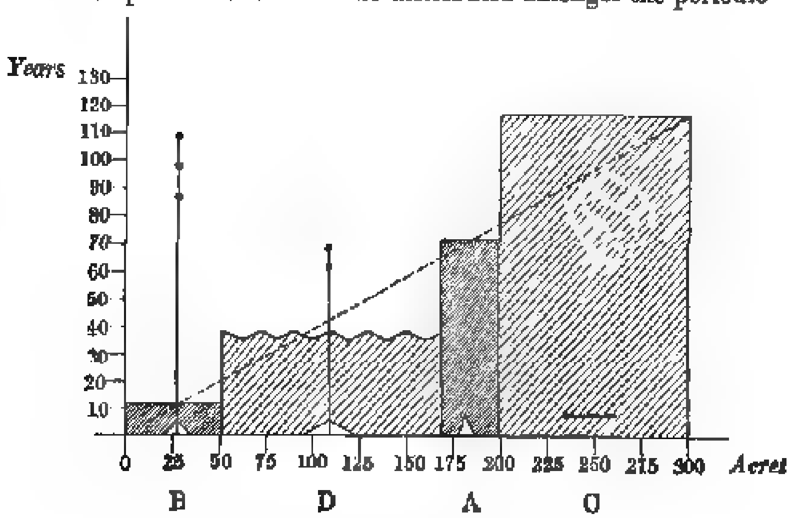
The inventory of the forest having been made, we will represent the contents of the compartments by the diagram given on page 238, Vol. VIII.

This inventory completed, and the compartments having been carefully and minutely described in order that the resources of the forest may be thoroughly ascertained, the figures representing the standing crops of the different compartments, according to their age and importance, will be compared. By ruling a straight line across the above diagram, it will be found that the line corresponding to the mean standing crop, will coincide with 110 years, *i. e.*, that the forest is constituted for a

rotation of 110 years, the period of exploitability, which we must first of all determine.



Having thus decided, the length of the periods will be fixed with reference to the requirements of forest growth in the locality; for instance, we may choose five periods of 22 years each. The compartments will then be distributed amongst the periodic



blocks so as to render the latter as uniformly productive as possible, and the cubic contents of the standing timber in the first block will then be estimated, in fact the method we have

already explained for making a working-scheme for the forest will be applied, and the capability determined by this procedure will be the solution of the problem.

The comparative accuracy of the result will depend on the care with which the details of the operation may have been carried out, and especially on the constitution of the periodic-blocks.

The principal difficulty consists in tracing the mean line in the diagram of the compartments, and this is greatly increased when there are considerable inequalities, or gaps, in the ages of the standing crops. It is a matter requiring all a forester's experience and tact, and its solution depends on a knowledge of the local laws of forest growth, as well as a proper use of the diagram.* But we must not fall into the error of supposing that this diagram will in itself suffice to solve the problem, for it only accurately represents two of the elements which combine to form a standing crop: age and area. The third element, the actual condition of the forest growth, *i. e.*, the density and volume of the standing crops, is only roughly indicated in the diagram. The forester must be able to appreciate the condition of the growth and of the productive power of the forest: he will make use of tables of rates of growth, from selected forests in the neighbourhood, to fix the position of the compensating line, and then to determine the capability of the forest. For a stored coppice, the same calculation will be made for the coppice, the stores in each compartment will then be counted according to their age, classes, and as far as possible the stumps of those which have been felled, and from these data, the number of stores to be felled annually will be deduced.

It is evident that we cannot here do more than indicate roughly the methods which the experience and skill of a forester alone can apply. Whenever any procedure is to be followed, however carefully it may have been drawn up, the person who is to apply it, must, first of all, be professionally skilled.

But the question may be more complicated; at the death of the head of a family, it may be necessary to determine what was the capability of a forest at the time of the marriage settlement, in order to settle the value of the amount to be resumed by the widow.

Or during the continuation of a life interest, the owner may fear the effect of certain fellings undertaken in the forest, and wish to ascertain what was the capability of the forest, before the life interest had commenced. This is to determine the capability of a forest after many fellings have been effected, after the lapse of many years, and when no inventory has been made and no record of fellings have been kept up.

---

* All Geometricians know the problem of the 3rd Book of Legendre for replacing a broken line, by a straight one which is equivalent to it.

Similar questions often arise in the law-courts; but it would be too hard on forestry to expect a precise answer to the question. The very data with which we start is an unknown quantity! The only possible procedure is to reconstitute the former state of the forest as well as we can, by inspecting the recent fellings and by comparing them with the surrounding compartments, using every possible means for arriving at the facts of the case. If successful in our attempt, if the documents are sufficiently clear, and too long a period has not elapsed, a fictitious inventory of the forest should be drawn up. We then proceed as before, and the comparison of the capability thus ascertained with that of the fellings already effected, will furnish the means of settling the dispute between the parties.

This is the only practical advice which can be given, and for the most part the question is insoluble. Such disputes are a frequent source of disunion in families, and of irritating law suits. In order to avoid them, a proprietor careful for the future, and above all things desirous of not bequeathing any cause for dispute to his heirs, will do well to prepare proper working-schemes for his forests, and to calculate their capability in the way we have pointed out.

NOTES FROM REWAH.

(*Continued from page 401*).

ONE of the most interesting parts of Rewah is the country east of the Sôn and Johilla rivers. The scenery here is always pretty, bold, varied, and sometimes even grand. Comparatively extensive tracts of cultivation are intermixed with forest composed of dark glossy Sarái and feathery bamboo; rivers and streams are plentiful, many of them being supplied with perennial springs, and hills are always within sight, some of which are sufficiently conspicuous as to be visible nearly throughout this part of the country.

The chief among them is the Bandogarh stronghold, which all over Central India has for years past boasted a great name for strength and exclusiveness. This place was originally the head-quarters of the Baghél Chiefs; but as the dominion of the clan extended northwards over the richer country beyond the Kaimurs, the capital was transferred to Rewah. No European had ever been allowed to ascend the hill or to pitch his camp within a radius of five miles from its base until after the death of the late Maharajah, when the Political Agent, as Manager and Superintendent of the State, thought it desirable to visit and inspect the fortress. I was invited to accompany him, and one morning in January 1881 we were escorted on elephants, from our tents some four miles away, to the base of the hill, which latter it was necessary to climb on foot. The hill is 2,662 feet above the sea, of which about 1,400 rises nearly sheer above the plain. The approach to it leads through a very beautiful gorge, which pierces a screen of outer and lower hills, and is filled with dense forest of Sarái, bamboo and wild mango, the ground being thickly carpeted with ferns and moisture-loving plants. Having cleared this gorge, Bandogarh stands boldly out, presenting a grand mass of greyish sandstone rock, isolated, and steeply scarped along its entire length with precipices. At first sight it would appear impossible for any one to arrive at the summit without the help of wings, but the road or rather pathway (which consists of rough steps hewn in the rock) gradually winds into a ravine, which is then seen to cut into the hill right up to its crest, and to admit of being scaled. Half way up this ravine our road was barred by a massive but rather dilapidated gateway, at which a guard turned out and took charge of us, and this too was considered the time for firing a salute—that distinguished perquisite of a P. A.—for on passing the gateway a report thundered out over head which made the old rock echo and re-echo, and continued rolling away among the neighbouring hills for long afterwards. Arrived at the summit, we passed through a fortified

curtain and gateway, placed to defend the top of the ravine, on to a plateau and into the middle of a queer looking crowd of Swashbucklers, who apparently viewed us with curiosity not unmingled with other feelings. Some of these gentry had been born and reared on the hill, and had never roamed more than a mile or so on either side. They consider themselves the hereditary guardians of the fortress, and as such receive some small privileges.

We wandered about the plateau, which is about one mile long by half a mile broad, but found nothing to reward us for our steep climb except an extensive view of hill and plain, which lay stretched before and below us like a bird's eye map in relief. Fortifications there were none, and the guns, of which I think we counted some 35 of all sizes, arranged round the edge of the hill and principally unmounted, may perhaps be judged from the fact that one of them burst in firing the salute—*Ex uno disce omnes.* Bandogarh in fact is only a strong natural hill fortress, which it would be difficult to take, but which could be starved out or still more easily outflanked: it could have no purpose in real warfare, except that of yielding a temporary harbourage to a small party of men, or of forming a hiding place for treasure in times of doubt and danger.

Having thus walked up to the top of the hill and spied out the nakedness of the land, we proceeded to the easier task of walking down again; and having done so, were shown several very roomy caves, partly natural and partly excavated, which we were informed had been occupied by Tippu Sultan and his followers in one of his expeditions into Hindustan, when passing through the Rewah State he tried to crack the Bandogarh nut, but only broke his teeth.

About 12 miles north of this hill fort, near the large village of Majholi, there is an area of forest 30 square miles in extent, which lately contained large numbers of mature Sarái trees of fine proportions. But sleeper operations were successfully carried on here for some years, until all, or nearly all, the big timber has been exploited. The cover is almost entirely composed of a higher tier of Sarái mixed with *Pterocarpus marsupium*, *Ægle marmelos*, *Millettia velutina* and *Boswellia thurifera*, and a lower tier of good bamboos. The soil is very sandy and unfitted for cultivation, unless well irrigated or fertilized with wood ashes, and with one exception, it is free of all rights other than those conferred by a short lease. A few large trees still remain, and the area for the most part is well stocked with small Sarái varying up to 3 feet girth, which, with the good bamboo crop, renders this forest well worth some special protection. Its situation is also good, being almost immediately east of the Bijairagogarh reserves in the Central Provinces, and about 30 miles from Jokai, the nearest station on the East Indian Railway. Its chief *raison d'etre* will be to help supply the future demand for timber and bamboos

from Myhere, northwards to Allahabad, in all which country there will soon be a great scarcity of the above material. It has been chosen for a reserve, and will be shortly demarcated.

Ten miles south of Bandogarh there is another very similar area containing some 20 square miles of mixed Sarái and hill forest, but the proportion of fairly large trees is here greater than in the Majholi reserve. The forest is traversed by a considerable stream and its tributaries, along which the *Shorea* is growing, while the hills are covered with the common deciduous forest of Central India mixed with bamboos. The southern border of this forest touches the proposed railway line from Umaria to Sohagpur, and its south-western corner is only 10 miles from the Umaria coal-field, the working of which, with the new railway lines, is expected to do great things for the State. The coal of this place has been analysed and declared of good quality; and the field though not so extensive as that on the Johilla or the one in Sohagpur, is estimated to contain 28 millions of tons of workable material, while it is hoped that the new system of railways for Central India, which it is proposed to connect with this place, will enable the pits to supply the coal burnt on some eight hundred or a thousand miles of line. Iron and lime are also present close at hand, so that Umaria, which is now only a medium sized village, has probably a busy future in store for it. It is principally with the timber demand of this place in view that the above Bandogarh reserve has been selected.

The chief large timber yielding area of Rewah is situated in Sohagpur and Singwará, a considerable distance to the south-east of the above blocks. Roughly speaking, this forest is comprised between the river Murna—a tributary of the Sôn—and the Maikal hills. It is not compact in shape, but covers the country in a patchy manner—long narrow strips being divided by cultivation or extensive grass lands, the sites of old village clearings. The Sarái is here nearly pure, bamboos are scarce, and the balance of cover is made up of *Emblica officinalis, Semecarpus Anacardium, Butea frondosa, Lagerstræmia parviflora* and *Boswellia thurifera.* A conspicuous species also, and one that was a stranger to me on arrival, is *Hymenodictyon excelsum*, which in favoured spots grows into a remarkably handsome tree, having leaves quite 2 feet in length.

The Sarái, and especially the larger Sarái, is found on the Murna and its feeders, principally the latter, which flow northward from the Maikal hills. The fine timber is represented by individual trees scattered at wide intervals over a large area, or situated in ravines and such places, to remove them from which will entail both expense and labour, and a large proportion of them are useless, being more or less hollow from age, the practise of ral tapping or the effects of annual fires. The best timber too, and especially all such as was growing in accessible places, has been already removed by sleeper contractors. The forest is scat-

tered over 100 square miles of country, but the forest itself probably does not represent more than 50 per cent. of this area.

The most extensive coal-field in India is believed to be present in this neighbourhood. Its limits have not been exactly defined, but the outcrops and *débris* of coal are so numerous and plentiful in the adjacent ravines and river beds, that there can be no reasonable doubt regarding its capability of yielding an enormous output. All that is required to develope the great mineral resources of this part of Rewah is a demand within a paying distance, and it is probable that within a few years, this indispensable condition may be partially fulfilled by the construction of the Nagpur and Calcutta and Kutni and Bilaspur railways, the former of which will travel sufficiently near to tap the Sohagpur coal pits, while the latter will be in actual contact with them. The preliminary survey of both these lines has been completed.

It will be readily understood that a forest situated in the vicinity of these lines and coal-field must be a useful and valuable property if capable of yielding good timber, and provided its protection can be effected without greatly interfering with the extension of cultivation. The Sohagpur and Singwara tract therefore, because it answers these conditions, has been remarked and reported on by the Forest officer, but unfortunately owing to difficulties in connection with the proprietory rights possessed by the Chiefs of the above *illaquas*, it has not been possible to reserve this tract.

These districts were transferred to Rewah from the old Sagar and Nerbudda territories, as a reward for the good services performed by the late Maharajah during the Mutiny. The local Chief of Sohagpur had given trouble to the Mandla authorities, who sent troops against him, blew up his principal forts, and were no doubt glad to be rid of a semi-independent and unruly neighbour. Sohagpur was taken in hand by Rewah, and made to pay a heavy *nuzzerána*, besides the usual *chowt*, or 25 per cent. on the land revenue collection of the district, in return for being allowed to continue in possession, while Hanúman Singh, the chief man in Singwara, who had distinguished himself in those rowdy times, and been presented with land and a sword of honour by the British Government, was created by Rewah—not without a substantial consideration—Rajah of the entire Singwara district. Both of these Chiefs were, however, among other things, made to yield up as royal perquisites, all forest trees from which sleepers could be made, and on which lac could be cultivated. The right of the durbar therefore in these southern forests consists only in felling such trees as it may require for sleeper making; the land is *talukdári*, and the local Chiefs are jealous of interference and tenacious of their rights in this respect, and object to expropriation on reasonable terms—*Hinc illæ lachrymæ.*

It will have been noted that, the above forest areas have been chosen more with the view of supplying a future demand, and that a foreign or special one, than of providing for local consumption and the requirements of the people of Rewah. The fact is that the latter are now, and will be for many years to come, most amply supplied from the extensive waste land that adjoins every village area below the Kaimurs, and as it has been considered unadvisable at present to charge a duty on forest material required for local consumption, it being supposed that the land revenue assessments are much heavier in Rewah than in other places, and that an additional forest duty would only result in a future falling off in the bids for Khalsa holdings, the durbar sees no way of protecting extensive areas of forest, for the general benefit of the people, from which it will reap no immediate or prospective reward.

Hence the Forest officer's attention when selecting areas for special treatment and protection has been directed only to such situations as may be fairly expected within a reasonable time to repay any money expended on them.

J. M.

(To be continued).

CULTIVATION OF THE BEAN.

(*Faba vulgaris*, Mœnch.)

THIS vegetable is an annual, and one of the oldest cultivated plants we possess. Some uncertainty exists as to its native habitat, however it is generally supposed to be a native of Persia. There are two distinct classes cultivated in gardens, viz., the long pod and broad Windsor. The pods of the former are from 5 to 9 inches long, and contain from four to six medium sized beans. Those of the latter are from 3 to 6 inches long and much broader than the long pod, and generally contain three flat large sized beans. There are numerous varieties detailed in European nurserymen's catalogues, however all are referable to either of these two classes. The long podded varieties are the most prolific, and succeed best in this country. They acclimatise without any perceptible deterioration in quality, and should therefore be always grown in preference to the broad Windsor sorts.

In the Plains, beans come in use about the middle or end of February, and continue in season until the end of April. They should be sown in succession from the middle of September to the end of October. Two sowings are sufficient for ordinary requirements, but when it is desired to have them in season for as long a period as possible, three sowings should be made at intervals of a fortnight between. They succeed best in a deep, rich, and somewhat heavy loam. Where the soil is light and sandy, heavy manuring must be resorted to in order to meet with success. I find the following to be a good and economical mode of preparing the ground. Dig trenches 1 foot deep and 18 inches wide, at distances of 3 feet apart for long podded, and 2½ feet for broad Windsor sorts. Half fill the trenches with old rich manure, and dig or fork it into the subsoil at the bottom of the trench. Then fill up the trenches with the surface soil and also give it a liberal supply of manure. The trenches will now form low ridges owing to the manure and looseness of the soil. They should next be pressed with the feet, and if the soil is still above the surrounding level, part of it should be drawn to each side, leaving a space 18 inches wide down the whole length of the rows. The soil drawn away may be left along both edges of the latter for the purpose of facilitating the retention of water when irrigating. The seeds should be inserted 2 inches below the surface, in double or single lines in each row at 6 inches apart and the same distance between the lines when two are sown. The double line is preferable to the single one for the following reasons. If the seeds are imported many of them fail to come up, and the

resulting vacant spaces, besides being a waste of ground, give the plot an untidy appearance. In a double row, vacant spaces, as a rule, are not so numerous, besides the plants are much benefitted by the support and protection they afford each other during storms.

The germinative power of the seeds is much increased by being soaked in warm water for six or eight hours before sowing. Care, however, must be taken that they are not again dried up by being inserted in hot and dry ground. When the latter is in the state mentioned, water should be given immediately after sowing, and the ground kept damp by subsequent waterings until the seedlings appear above ground. During their progress, water should be freely given, the ground kept free of weeds, and the soil frequently stirred between the plants. When the flowers begin to appear, a slight earthing up around the neck of the plants is beneficial. When the stems are well covered with flowers or when about 1½ or 2 feet high, the point of every shoot should be nipped out. If this is not done they will continue to grow and flower without forming any pods. As already mentioned the long pod acclimatizes readily. When seeds for future use are desired, they should be collected from the pods lowest down on the stems, as these are invariably the largest and best developed. The bean is not subject to disease or to the attacks of insects when cultivated on the plains.

On the Hills—autumn sowings come in use in May, and by successive spring sowings beans can be kept in season until August and September. A small sowing should be made in October or November for the early crop of the following spring. Those for the main crops should be sown in succession from the beginning of March to the end of May, at intervals of a fortnight between. The mode of cultivation is the same as described for the Plains, and need not again be detailed. The plants are sometimes attacked by a species of Aphis or green fly. The best remedy is frequent syringings with soap and tobacco water.

W. G.

DEMARCATING FOREST RESERVES.

In the April Number of the "Indian Forester," there appeared a letter on the subject of demarcating forest reserves by means of boards *nailed* to trees. It may perhaps interest the writer of that letter and others engaged in demarcation work to know the method about to be adopted in the Southern Division of the Bombay Presidency.

The boards employed are made of teak, 26 inches long, 10 inches broad, and 2 inches thick; they are painted white with the letters in black. The upper and lower edges of the board are bevilled (*see Plate*). The fixing of the board is most simple:

the tree is first of all deeply flashed so as to obtain a smooth surface, and afterwards two grooves are cut corresponding to the bevilled edges of the board, and into which these latter slide. No nail therefore is required.

The advantages of this system are obvious; the board cannot possibly work loose, nor can it be driven out by the growth of the tree. The sole disadvantage is that after several years the bark begins to grow over the board, but this encroachment can easily be remedied by cutting.

The boards are turned out at the Canara Saw-mills at a cost of 4½ annas each, while the painting, cutting of letters and fixing bring the total cost up to about 11 annas per board. In the right hand corner the designation of the block is given, and in the left the consecutive number of the board.

The system has been already tried in the Belgaum district for several years past and with excellent results, the boards being still in perfect order. In the Dharwar district the forests are demarcated by stone cairns, which are very expensive, Rs. 4 each, and require frequent repairs. In Canara itself the demarcation is not yet completed, but during the next working season the whole of the forests will be demarcated by boards after the manner I have just described.

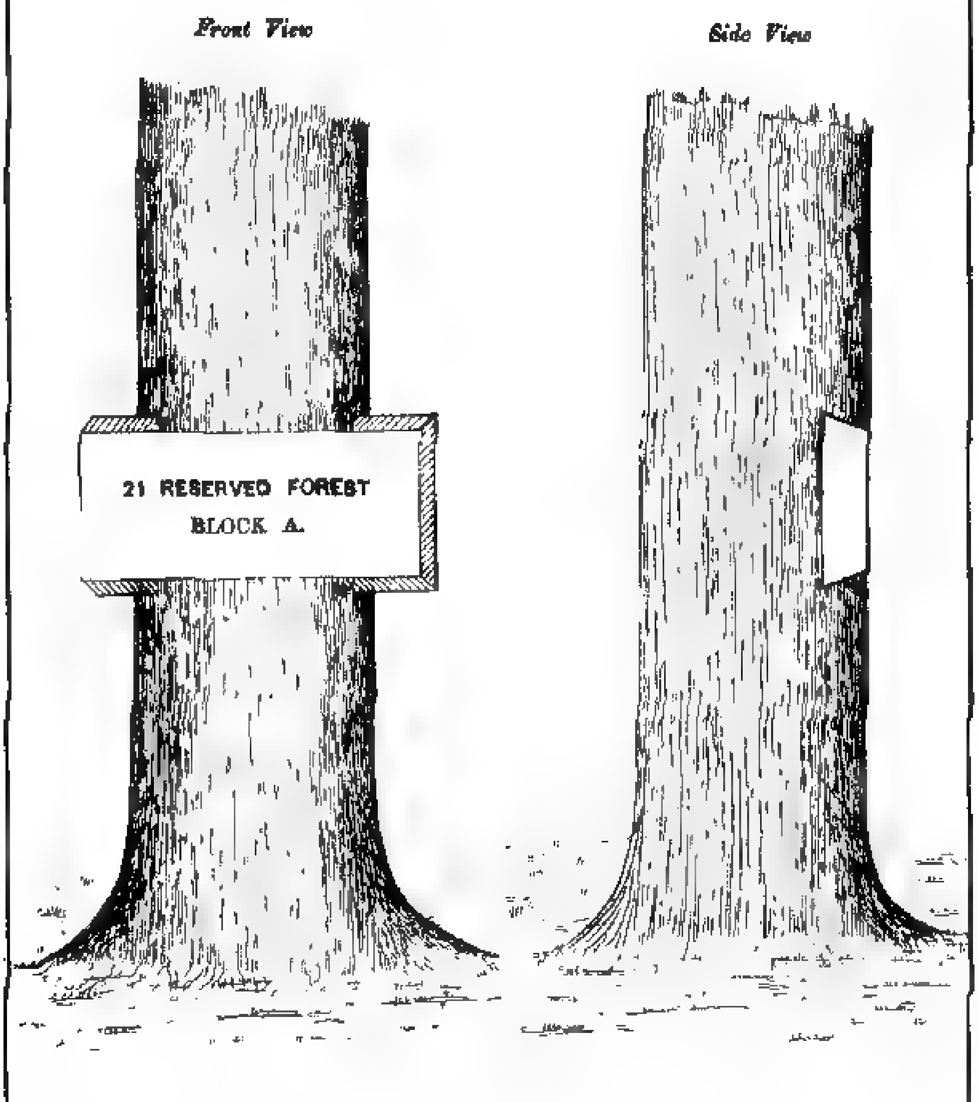
KENDAL.

NOTE ON EXPERIMENTAL PLANTATIONS ON USAR.

DURING December 1882, I visited the Pardilnagar plantation near Sikandra Rao, in the Aligarh district, and the seven plantations (six made by Mr. Wilson and one by Mr. Crook) near Awa.

2. The term "*úsar*" appears to be used by the natives to denote barren wastes, more or less clothed with grass, and more or less impregnated with *reh*, the soil of which is unfit for profitable cultivation. Almost every plot of *úsar* land has *some* patches of soil good enough to grow trees without any special preparation, but the variation in this respect is very considerable, no two plots being alike. A simple and reliable way of finding the good patches in an *úsar* plot is to stop grazing for a year, and then examine the ground. On the good patches you will find *dúb*, *dáb*, and other kinds of grasses; but on the bad soil, *i.e.*, soil highly impregnated with *reh*, only *one* kind of grass grows, and I have never found that grass on any other description of soil. *N.B.*—By "good" *úsar* soil is meant soil which is good enough to grow *kikar* trees without any special preparation of the soil; and by "bad" *úsar* soil is meant soil so impregnated with *reh*, that, although *kikar* will probably grow if once well established, the experiments appear to show that the pits in which the seedlings are planted must be filled with good soil, so as to give the young

DEMARCATING FOREST RESERVES.



Litho, T. C. Press, Roorkee.

Thos. D. Sona, Supdt.

trees a start, and enable them to make sufficiently vigorous growth to send their roots deep down into the earth below the 3 or 4 feet of *reh*-impregnated surface soil. Eleven acres of the Pardulnagar plantation (which is on *bad úsar*) were planted in this way some eight or nine years ago, and some three-fourths of the area is now densely covered with *kikar* trees of 20 feet or more in height.

3. The last two years' experiment near Awa has proved that transplanting strong carefully removed seedlings is better than sowing on bad *úsar*, and that moderate watering by trenches is far better than flooding. The Pardulnagar plantation was formed by *sowing*, and it has constantly been *flooded*; but notwithstanding this, it is a success, and it proves pretty conclusively that *kikar* trees *will grow* on "bad" *úsar* if the young trees are given a start by being planted in pits filled with good soil.

4. When the Awa experiments were first tarted, it was thought by many—myself amongst the number—that the light shade of *kikar* trees would materially assist the growth of grass. The experiments have, however, proved that this is not the case. *If the land is protected from grazing*, a good crop of grass will spring up on all parts where there are grass roots; and this *úsar* grass has such a strong tendency to throw out long shoots, which take root at every joint, that no doubt it would in time cover all the bare patches. This, however, can be greatly expedited by planting. Several of the very worst patches, which were quite white with efflorescent *reh*, were planted with *úsar* grass last rains with the most perfect success: every root seems to have struck.

5. *Usar* reserves—whether reserved for grass alone or for grass and timber combined—must be fenced and protected; and as the cost of fencing and protection and the prime cost of the land cannot be covered by sale of grass alone, it will be necessary to make further use of the ground by planting it with suitable trees, if it is desirable to make the scheme remunerative. Moreover, trees like *kikar** and *chounkar*† yield a considerable amount of cattle fodder, and the light shade from them does not interfere with the growth of grass. therefore, by having the ground judiciously stocked with such trees, the annual yield of fodder is increased, and the crop of trees will be worth from Rs. 50 to Rs. 100 per acre after from 20 to 25 years' growth.

6. Allowing that trees (I allude to *kikar* and *chounkar* only) neither promote nor impede the growth of grass on *úsar* land, and bearing in mind that every tree artificially planted costs a certain amount of money, it will now be interesting to consider the number of trees to plant per acre which will give the best return.

7. Neither of the trees alluded to are benefited by being planted close together: they prefer plenty of space on all sides from the very first. *Mature kikar* trees should be fully 40 feet apart

---

* Acacia arabica. † Prosopis spicigera.

(27 per acre): *chounkar* might be a little closer than that, but as their shade is denser than *kikar*, the same distance will do for both.

Mr. Buck's estimate was, I believe, for lines of trees 20 feet apart, with the trees planted at 10 feet apart in the lines, or 218 trees per acre.

As it has since been proved that tree shade does not assist in promoting the growth of grass, and as the trees have to be thinned to 20 feet apart before they are large enough to pay for the cost of their planting and tending, I think it may be accepted as a standing rule that, in *ûsar* plantations, trees should never be planted closer than 20 feet apart, or 109 per acre. On "good" *ûsar* I think it would be *profitable* to plant at 20 feet apart, for thinning to 40 feet apart would not be necessary until the trees were seven to ten years of age, and at that age they *should more than repay their cost. On "bad" ûsar the trees* might be planted at 40 feet apart (27 per acre), and the money saved by planting only one-fourth the number of trees should be spent on making the pits 4 feet deep (instead of 3), and filling them with good soil, so as to give the seedling a start, and convey its roots past the *reh*-impregnated surface soil into the good sandy loam subsoil.

8. Another fact which has been proved by the Awa experiments is that *flooding* is injurious to young trees planted on *ûsar*, and that the best way to give water is to lead it into small channels one foot broad and one foot deep, running along the edges of the lines of trees, the water being allowed to stand in the channels for several hours, and percolate into the pits in which the trees are planted. This of course is a great saving of water, and the further apart your lines of trees are, the less water you will require.

9. Another standing rule for *ûsar* plantations should be not to renew vacancies more than twice. If a tree will not grow in a certain spot after three trials, it may be concluded that it is not worth while to spend more money on it, and the place should be left blank. *I observed instances of a solitary chounkar tree* flourishing in the midst of several dead *kikar* on very "bad" *ûsar*; so perhaps it would be a good plan, when several *kikar* have failed in one place, to renew the vacancies with *chounkar*.

10. The nurseries for raising the seedlings should always be made on a selected bit of "good" soil; and to save the expense of carriage, which is considerable, the nursery should be within the plantation. The land should be ploughed after the winter rains, and again two or three times during April and May. Sow the seed early in June, and when the seedlings are about 4 inches high, which they will be by July, prick them out in the nursery at 2 feet apart. These seedlings will be about 2 feet high, and fit for transplanting at the commencement of the following rains.

11. The best time for transplanting is during the first two or

three weeks of the rains; but if it cannot all be done in that time, the next best time is December and January. Transplanting *kikar* and *chounkar* requires very great care. These trees are inclined to throw out long roots; and if one of the main roots gets injured during the removal of the tree, that tree generally dies. This is the reason why *ploughing* the nurseries is better than digging: if the ground is deeply dug, the roots of the seedlings penetrate to such an extent that it is almost impossible to dig them up without injury.

12. Transplanting should never be done when the soil is so dry that the earth will fall away from the roots. Each seedling should be carefully dug out with a ball of earth about 9 inches in diameter and from 2½ to 3 feet long.

Grass must be bound round the ball to prevent the earth falling, and then the plant should be carried to the pit by two men on a rough stretcher and planted at once. The success of a plantation depends almost entirely on the care bestowed on the removal of the transplant and on the season during which the transplanting is done.

13. One other fact worth mentioning regarding *usar* plantations, which has been proved by the Awa experiments, is that *kikar* grows very well on the hard, bare lowlands so common on *usar* plains, where water has lodged during the rains. Strong transplants from 2 to 3 feet high should be used, and they should be planted during December and January.

G. Greig.

COCHINEAL.

TO THE EDITOR OF THE "INDIAN FORESTER."

Sir,—There are a great many cochineal insects in our forests. Could you please tell me if it would be worth while to collect them as 'minor forest produce'? If so, how should they be preserved and collected? To whom should we apply in order to get a sale of them? What is the price of cochineal in England.?

K. I. A.

"K. I. A." may be guided by the following facts in forming an opinion as to the advisability of collecting cochineal as "minor forest produce."

It has been calculated that about 70,000 insects go to the pound, and the price in London in June 1864 (the only price list we have at hand) was from 3*s.* 3*d.* to 4*s.* 4*d.* per one lb. of good cochineal. The insects are detached from the plants by means of a blunt knife, they are then dipped into boiling water to kill them, and are finally dried in the sun. Thus prepared, they may be put into bags, as they do not deteriorate by keeping.—[Ed.]

IV. Notes, Queries and Extracts.

Tree Pruning.*—Bark once injured or loosened can never attach itself again to the trunk; and whenever wounds, abrasures, or sections of loose bark exist on the trunk of a tree, the damaged part should be cut away cleanly as far as the injury extends. Careful persons have been known to nail on to a tree a piece of loosened bark, in the hope of inducing it to grow again, or at least of retaining on the young wood its natural covering. Unfortunately the result produced by this operation is exactly opposite to that intended. The decaying wood and bark attract thousands of insects, which find here safe shelter and abundant food; and, increasing rapidly, hasten the death of the tree.

In such cases, instead of re-fastening the loosened bark to the tree, it should be entirely cut away, care being taken to give the cut a regular outline, especially on the lower side; for as has been already explained, if a portion of the bark, even if adhering to the wood, is left without direct communication with the leaves, it must die and decay. A coating of coal-tar should, of course, be applied to such wounds.

Loosened bark.—It is necessary to frequently examine the lower portions of the trunk, especially of trees beginning to grow old; for here is often found the cause of death in many trees, in the large sheets of bark entirely separated from the trunk. This condition of things, which often cannot be detected except by the hollow sound produced by striking the trunk with the back of the iron pruning knife, arrests the circulation of sap, while the cavity between the bark and the wood furnishes a safe retreat for a multitude of insects, which hasten the destruction of the tree. The dead bark should be entirely removed, even should it be necessary in so doing to make large wounds. Attention, too, should be given to injuries to the bark caused by the fall of neighbouring trees. These may remain hidden for years, and are often only detected by the peculiar sound produced by a blow of the pruning knife. Cases of this nature require the treatment recommended for the last class.

Cavities in the trunk.—Very often when a tree has been long

---

* Translated from the French of A. des Cars, by Charles S. Sargent, Professor of Arboriculture in Harvard College, U. S.

neglected, the trunk is seriously injured by cavities caused by the decay of dead or broken branches. It is not claimed that pruning can remove defects of this nature: it can with proper application, however, arrest the progress of the evil, and in such cases should always be resorted to. The edge of the cavity should be cut smooth and even, and all decomposed matter, or growth of new bark formed in the interior, should be carefully removed. A coating of coal-tar should be applied to the surface of the cavity, and the mouth plugged with a piece of well-seasoned oak, securely driven into place. The end of the plug should then be carefully pared smooth and covered with coal-tar, precisely as if the stump of a branch were under treatment. If the cavity is too large to be closed in this manner, a piece of thoroughly seasoned oak-board, carefully fitted to it, may be securely nailed into the opening, and then covered with coal-tar. It is often advisable to guard against the attacks of insects by nailing a piece of zinc or other metal over the board, in such a way that the growth of the new wood will in time completely cover it.

These operations resemble, if such a comparison is admissible, the fillings performed by dentists, and with the same object, to check the progress of decay.

The use of Coal-tar.—Coal-tar, a waste product of gas works, is a dark-brown imperishable substance with the odour of creosote. It can be applied with an ordinary painter's brush, and may be used cold, except in very cold weather, when it should be slightly warmed before application. Coal-tar has remarkable preservative properties, and may be used with equal advantage on living and dead wood. A single application without penetrating deeper than ordinary paint forms an impervious coating to the wood cells, which would without such covering, under external influences, soon become channels of decay. This simple application then produces a sort of instantaneous cauterization, and preserves from decay wounds caused either in pruning or by accident. The odour of coal-tar drives away insects, or prevents them, by complete adherence to the wood, from injuring it. After long and expensive experiments, the Director of the parks of the city of Paris finally, in 1863, adopted coal-tar in preference to other preparations used for covering tree wounds, as may be seen in all the principal streets of the capital.

Employment of Coal-tar on Fruit Trees.—It is for this reason that the application of coal-tar should not be made except with considerable caution in the treatment of wounds on drupaceous fruit trees (cherries, peaches, plums, &c.), and especialy on the plum tree. It has often been observed that the bark of fruit trees of this class have suffered from the application of coal-tar. This is not the case, however, with pome-bearing trees (apples, pears, &c.); to these coal-tar may be applied with perfect safety.

It must not be supposed from these remarks that coal-tar can-

not be used on the plum or other trees of its class. On the contrary, there is no substance which can replace it in the treatment of large wounds on these trees, but it should be used cautiously, especially in the case of young trees, and should not be allowed to needlessly run down the trunk; and it is well to remember that the more active a remedy, the greater the care necessary in its application.

The practice of leaving a short stump to an amputated branch, adopted by some persons to prevent the loss of sap, although less objectionable in the case of coniferous trees, should never be adopted. Such stumps must be cut again the following year close to the trunk, or cushions of wood will form about their base, covering the trunk with protuberances. These greatly injure the appearance and value of the tree, and necessitate, should it be found desirable to remove later such excrescences, wounds two or three times as large as an original cut close to the trunk would have made.

The custom of pruning pines is very general in France, and is often carried to excess. The removal of all branches, with the exception of a few at the top of the tree, must greatly interfere with the growth in diameter of the trunk, and healthy branches should not be removed for the sake of creating a clean trunk of more than one-half, or at the most two-thirds, of the entire height of the tree. The general rule of pruning already explained in the case of deciduous trees, and which establishes a portion between the number of branches which should be removed and the size of the tree, might with advantage be more generally applied in the treatment of pines.—*Tropical Agriculturist.*

AUSTRALIAN TREES ON THE NILGIRIS.—Dr. Brandis, the Inspector General of Forests, wrote as follows in a note to Government in May 1882:—"The plantations of Australian trees on the Nilgiris now cover a considerable area, and some of them have been already cut over. The oldest of these plantations date back as far as 1857, and, considering the extremely rapid growth of the Blue-gum and the large Acacia, it is time now that the rate of growth, and tables of growing stock per acre, at different ages, be drawn up. These tables must be based upon the examination in detail of most of the existing plantations on the plateau, and they will furnish data for estimating the outturn of thinnings, and the final crop at different ages. The enquiries which must be made for this purpose will probably also lead to clearer views regarding the principles by which thinnings, the formation, and the treatment of these plantations generally should be regulated. It will doubtless be found necessary, sooner or later, considerably to extend these plantations on the plateau, and the results, which the enquiries here suggested will furnish, will be found useful in arranging these operations in a systematic

manner." The Government of Madras concurred with Dr. Brandis in these views, and the services of Mr. Hutchins, of the Mysore Forest Department, were made available for this duty. He devoted 4½ months to the work, and has submitted to Government a most exhaustive report, which contain full details of the methods adopted and the results. These include reliable data as to the average annual increment per acre or individual tree, and the reducing factor necessary for calculating the same.—*S. I. Observer.*

THE SAL (SAUL) TREE (*SHOREA ROBUSTA*).

N. O. *Dipterocarpaceæ.*

DEAR SIR,—How comes this magnificent Indian timber tree (named by Gært. after "*Sir J. Shore*—Lord Teignmouth, Governor-General") to be called Sál, which is the correct Persian name for the Teak (*Tectona grandis*)? Sál is apparently a Bengali term.

GHORE PORR.

THE DECCAN, 19*th July*, 1883.

—*From the Asian.*

CHANGES AT THE NANCY FOREST SCHOOL.—A friend home on furlough writes as follows regarding his late visit to Nancy:—"The old song is fulfilled—'Le forestier gai et content est supprimé par règlement.' The *manteau* is replaced by a machine resembling what ladies call a Langtry Cape. Tight æsthetic breeches instead of the baggy trousers of old, and a sword, over which the *élèves* are always tumbling, represents the dear old toothpick. 'Il ne reste que la casquette,' and that they are ashamed of. Ichabod! the glory is departed. They salute each other every time they meet, and play at soldiers. 'Eheu fugaces!' Put the above into the 'Forester' inside black lines one inch wide." But these are trifles; we are, however, glad to contradict a rumour partly due to a circular letter regarding a subscription list for a memorial to the late Professor Bagneris, that the training of candidates for the Indian Forest Service at Nancy will shortly be discontinued. We sincerely hope that the Indian Forest Service will profit for many years to come from the excellent instruction in Forestry which Nancy affords.

THE LIFE OF TIMBER.—The ordinary life of unprotected timber structures is not more than twelve or fifteen years. Timber exposed to moisture in the presence of air, especially if in a warm place, or to alternate wetting and drying, will decay rapidly.

Sap and moisture retained in timber, by painting or closing in the sticks before they are seasoned through, will cause decay of a very insidious kind, as it works in the interior, leaving an apparently sound exterior or skin, which is the layer that had an opportunity to season. Paint on unseasoned timber is, therefore, more hurtful than serviceable. Large sticks of timber dry so slowly that, before they are seasoned throughout, decay may begin, and hence pieces of small scantling are preferable to large ones. Dampness and a lack of ventilation combined will hasten decay. The best seasoned timber will not withstand the effects of exposure to the weather for much over twenty-five years.—*Lumber World.*

INDIAN FORESTER.

Vol. IX.] October, 1883. [No. 10.

TRANSLATION OF M. PUTON'S AMÉNAGEMENT DES FORÊTS.

APPENDIX.

Administration of an estate consisting of several Forests.

THE question has often been proposed as to what kinds of records should be kept up, and what system of management employed, in dealing with an extensive forest property.

I shall not pretend in a few pages to deal fully with a matter involving so many weighty interests, but shall only offer a few remarks from my own experience, as the question is well worth study and reflection.

In 1872, I visited the important forest estates of the N...... family, which I had before inspected in 1865. The object of my visit, was not so much to study the forests from a cultural point of view, nor to examine the actual system of working, but to gain information regarding the supervision of such a large forest property.

The landed estates which this family has been wise enough to preserve undivided for several generations, are managed in behalf of the different branches of the family, by the Duke de N......, the present head of the family.

The forests are situated in different parts of Luxemburg, Switzerland and France. In 1860, working-schemes for their management were drawn up by foresters from the Nancy Forest School; they contain 75,000 acres, and thus equal in extent the average area of a State Conservator's charge.

The Duke of N......, with great kindness, offered to assist me, and conducted me to his office, where a large map was hanging, in which some pins with red and black heads were fixed. "It is from this place," said he, "that I direct the exploitation of our forests."

"My staff is reduced to what is absolutely necessary; an agent, who on his own responsibility directs all the work in his circle, is the local unit of management, and a few inspecting officers whom I send to the different places, and whose progress I follow on the map by means of the pins, form my controlling staff.

"As forest-guards, I have only wood-cutters, who are placed under the supervision of an overseer, a woodman too, and who are engaged by the year, and paid at the rate of 3 or 4 francs a day. This may appear to be an expensive system, but wood-cutters are easily attracted from the forests by the more remunerative wages obtainable in towns and manufactories, and it is dangerous to expose forest-guards on insufficient pay to temptation. Taking everything into consideration, it is a great advantage always to have skilled wood-cutters available without the necessity for employing contractors. My wood-cutters execute all fellings, except those of large trees which can be sold standing, undertake earthworks, plantations, repairs of roads, &c. A few hours in each working day, according to circumstances, are spent in patrolling.

"The work is regulated in the same way as in manufactories; the zeal of the workmen being stimulated by offers of reward for rapid execution. Finally, my workmen, at certain seasons, are employed in cultivating our lands which adjoin the forests.

"Agriculture approaches sylviculture in so many directions, that the two interlap, and the whole property is greatly benefitted by their mutual assistance.

"The basis of my system of administration is to have good working-schemes. Without this I consider reasonable management impossible The working-scheme is the agreement-bond between the proprietor and the administrator of each working circle, and only by means of it, can the latter be allowed that liberty of action which, founded on responsibility, raises man above the condition of a mere machine, and interests him properly in his work. The working-scheme alone permits a proper control of his management, and affords the inspecting officer a basis apart from purely personal observations which will always give rise to controversy. The working-scheme should have a special and uniform system, adapting itself to the verification and control of results. The simple method so successfully introduced into France by Lorentz and Parade, and so well taught at the Nancy School, will thoroughly satisfy this condition.

"Whatever may be the nature of the locality, and of the cultural exigencies, the main outlines of the working-schemes can be uniform throughout. For instance, in coppices, the annual coupe is in reality a periodic block with a period of one year. In high forests, the compartments correspond to permanent differences of forest growth. The grouping of compartments into periodic-blocks, the selection of longer or shorter periods according to the difficulties of regeneration, the choice of the rotation, according to the object held in view by the proprietor, are made so as to assure all conceivable economic and cultural conditions. These factors can be definitely fixed, or modified as necessity arises, without altering the main outlines of the working-scheme.

"The second difficulty was to assure an effective control of the working-schemes by means of records, which should be at once simple and capable of centralization. This has been carried out by withdrawing from the records all facts concerning labor bills, sales, works, all that relates to verifying the estimation of the standing crops, everything, in a word, which relates to the administration of the

property. These subjects are relegated to auxiliary books, and have nothing to do with the carrying out of the working-schemes.

"Thus reduced to manageable proportions, the records of the working-schemes, show clearly, at any moment, and after a mere glance, what point of the working-scheme has been reached, and how it is being applied.

"The administrative side of the management of each forest has been assured by special system of records, or rather by a summary of each year's receipts and expenses.

"I have been obliged to put an end to the submission of general reports, in which the writers, more or less plainly, harp their own praises, and only accept tabular statements of results which allow comparisons of the net proceeds of my estates to be made from year to year.

"Such are the outlines of my system of administration; and the practical working, under the three heads I have given, are as follows —

"The working-scheme of each forest is summarised in three tabular statements in the following manner :—

"The first statement gives the general heads of the working-scheme, and contains the reducing factors of the standing crop in cubic metres, as adopted for the capability and the valuations.

"The second statement relates to the general scheme of working, and with a few slight modifications is equally applicable to coppices, regular high forest, or forests managed by selection.

"The third statement includes the special part of working-schemes for high forests, and would naturally have no application for coppices. The summaries in these tabular statements have been prepared with the sole object of clearly setting forth the figures which I always require, for ready reference. They are not by any means a substitute for the draft working-scheme, which is kept by the local administrator.

Forest of ....
belonging to ....

Working Circle No.

Name ....
Area ....

System of management,* ......
Rotation, ... years.
Period, ... years.
No. of periodic blocks,† ....
Volume of standing timber,‡....... ..
Year of commencement of the working-scheme,............
General features of the working-scheme,§.....................

* Coppice, stored-coppice, high forest, or selection forest.

† In coppices, *periodic block* is replaced by *coupe* (*felling*).

‡ A note should be added as to the density of the crop superabundant or insufficient if the forest is being *converted*.

§ The general character and object of the working-scheme should be stated in a summary way.

Reducing factors.

Diameter.				
0·20 metres,	...	...	...	cubic metres.
0·25 "	...	...	...	"
0·30 "	...	...	...	"
0·35 "	...	...	...	"
0·40 "	...	...	...	"
... ...	...	...	...	...

General Table of Fellings.

Nomenclature		Areas		Actual age in (18).	Period for working.	Age at time of working.	Remarks.
Of periodic blocks.	Of compartments.	Of periodic blocks.	Of compartments.				
1	2	3	4	5	6	7	8
					(18..-18..)		General notes regarding works of improvement.

In coppices, columns 2 and 4 will be blank. In stored coppices at the head of column 8, the plan for reserving stores should be noted.

Special Table of Fellings for the first period, from 18 to 18*

Compartments.	Areas.	Description of standing crop.	Actual age in 18 .	Nature of operation.	Extent of felling, by area.	Remarks.
1	2	3	4	5	6	7
§ 1. Abnormal produce, or that beyond the scope of the working-scheme.						Approximate estimate of the normal volume to be felled.
A. *Fellings by volume.*						Total volume to be felled, distributed as follows:— 1 Ordinary fellings,.. 2. Fellings in the reserve,........ 3. Extraordinary fellings, ... Total, ..
B. *Fellings by area.*						Works to be executed in the first period.
§ 2. Normal produce, or that within the scope of the working-scheme.						Revision of estimate made in 18 .
A. *Fellings by volume.*						Total volume to be felled, distributed as follows — 1. Ordinary fellings,.. 2. Fellings in the reserve, ... 3. Extraordinary fellings, ... Total, ..

"The record prepared each year for registering the progress of the working-scheme, only includes one simple and uniform statement, adapting itself by means of slight modifications, to every system of management: coppices, high forests, selection forests. It is merely a debit and credit account for each period and for every compartment, and only differs in form from that generally adopted, so as to represent the facts of the case in a more striking manner. A separate register is kept for each class of fellings prescribed by the working-scheme. Thus in stored-coppice, there are generally two registers, one for the coppice, and one for the stores; in regular high forests, there are two or three registers; in forests under conversion

* This table will not be required for coppices, only the notes given in column 7 will be added to the general table of fellings, which alone will be required.

their number may be further increased. The figures for ordinary fellings are written in black ink, and in red for the fellings in the reserve, and in blue for extraordinary fellings.

Register of the working-scheme. Period from 18 to 18 . Fellings by *

							Fellings.			
Periodic blocks, †	I.									
Compartments, †	Ia.	Ib.	&c.			Total.	Ordinary.	In reserve.	Extraordinary.	Remarks.
Cubic contents or area to be felled,	‡	‡	‡			§	‖	‖	‖	
188 , ...										A separate register is kept for each succession of fellings prescribed in the working-scheme.
188 , ...										When the cubic contents of the standing crop is revised, the table is closed by a line, and a fresh register commenced.
188 , ...										

"Thirdly, we have the register of management in two statements, one for receipts in material, and in cash, and the other for expenditure.

"The former will include produce not provided for in the working-scheme: windfalls, dead trees, fellings in forest areas beyond the limits of the working-scheme. We thus have—

"Amongst the foreseen produce—*1st.* The principal produce, that which is given in the calculation of the capability either by area or volume. *2nd.* The secondary produce, due to clearings or thinnings. Amongst the unforeseen produce, there is no reason for distinguishing between the *principal and secondary produce*. *there is only accidental* produce.

"Finally, under the cash receipts, *accessory produce* includes the proceeds of game, fish, pasture, and any produce other than wood and timber.

"The fellings by area are entered both by area and volume, the

* Area or volume.

† Only the periodic blocks and compartments in which fellings are prescribed by the special table of fellings should be entered. In the case of coppice, the periodic blocks are replaced by *coupes*.

‡ *Volume, or area, as the case may be.*

§ This column gives the following information:—In the heading, *the total volume, or area, to be worked,* and below, *the volume worked each year.*

‖ In order not to lose sight of them, the figures from the special plan of felling (remark column) will be entered here. A note will be made if the increase due to growth is included in the reserve.

latter resulting from estimate or actual cubage according as the trees are sold standing, or after being logged.

"The statement of expenditure only comprises the special charges for each forest, namely, those which depend on the local management, and which the necessary supervision of the latter involve. Judicial charges and those of the control department are of a general nature. I could distribute them proportionally according to the area and importance of each forest, but they depend more on myself, and on external causes, than on local management, the results of which I wish to appreciate. For this reason I do not allow this head of expenditure to enter into the accounts of the separate forests.

"The record closes with an account of each year's results, *i.e.*, the number of *cubic* feet per *acre*, the cash yield per *acre*, and the average price of a cubic foot of timber, obtained by dividing the net income by the total yield in material. Before doing this, the expenditure for protection, working, and maintenance is deducted from the gross income. A special column shows the expenditure per acre, on works of improvement. The original cost of these works is brought forward year by year; that of maintenance is only included in the annual charges.

"Each of these statements only requires a few lines to be written up each year, and I hear from one of my local forest agents, who has a charge exceeding 15,000 acres in extent, that he only spends one day at the end of each year, in writing up the figures of all those statements. Each agent, in his own division, fills up the statements on a fly leaf, which is submitted to the inspecting officer, and after the latter has checked the figures, the final entry is made in the registers kept in duplicate by both officers. Thus prepared, these records may serve to check results on the ground.

"It will be of interest, continued M. de N......, to bring to your notice the results of this system of management.

"Since my forests have been placed under working-schemes, all my agents have become thoroughly acquainted with the tables of fellings; and the operations have acquired a degree of precision previously unknown; the works of maintenance and improvement are made without hesitation at the proper time and place; the fellings in each separate periodic block are made scientifically, so that the mere mention of the index and number of any compartment to the humblest wood cutter, will remind him of the proper way in which the felling should be executed. The employés are interested in their work, and attached to the forest.

"Such are the general results.

"Regarding the control of the working-schemes, nothing can be easier. The inspecting officer who wishes to examine the annual fellings on the spot, under each local agent, can at once, by means of the records of the working scheme, ascertain whether or no the provisions of the latter have been followed, what remains to be felled in each compartment, and when the last felling was made. At the slightest suspicion of any incorrect procedure, he goes to the spot. Railways have not been made for nothing, and our large manufacturing firms have thoroughly appreciated the advantages of the iron way, enabling them to reduce their directing staff, and to send inspecting officers wherever their presence may be required.

Register of Management—Receipts. Period from 18 to 18 .

	MATERIAL.									CASH.									
	FELLINGS PRESCRIBED.					FELLINGS NOT PRESCRIBED.				HEADS OF RECEIPTS.					DISTRIBUTION OF INCOME				
	Principal produce		*Secondary produce.*			*Accidental produce.*													
Date.	Area.	Volume.	Area.	Volume.	Total.	Compartments.	Area.	Volume.	Grand Total.	*Principal produce.*	Secondary produce.	Accessory produce.	Accidental and unforeseen produce.	Total annual gross income.	Ordinary income.	Do. from the reserve.	Extraordinary do.	Annual expenditure on works.	Remarks.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Columns (2), (4) and (8); number of trees, or area, according to the nature of the fellings. (14), Dead wood, and windfalls not included in the estimate of the capability, wood burned, injured by cattle, and clearings from lines and roads. (13), Va ue of produce other than wood, game, fish, pasture, minerals, &c. (20), In this column, the quantity of timber and firewood removed each year from the forest may be noted.

Register of Management—Expenditure. Period from 18   to 18 .

Date.	EXPENDITURE.						RESULTS.					Remarks.
	Cost of timber works.	WORKS OF IMPROVEMENT.				Total expenditure.	PRODUCE, PER ACRE		COST OF WORKS OF IMPROVEMENT, PER ACRE.		Average price per cubic foot.	
		Forest operations.		*Other Works.*								
		Original cost.	Mainten-ance.	Original cost.	Mainten-ance.		In volume.	In cash.	Original cost.	Mainten-ance.		
1	2	3	4	5	6	7	8	9	10	11	12	13

Columns (3), (4), Plantations, seedlings, culture, &c.
(5), (6), Roads, saw-mills, houses.
(8), Figure of Col. (10) of the preceding Statement divided by the area.
(9), Figure of Col. (15)   do.   do.   do.
(10), The figures of Col. (3) and (5) are added up and carried on from year to year, and the sum divided by the area.
(11), The figures of Col. (4) and (6) are added up (but not carried on), and the sum divided by the area.
(12), From the figures of Col. (15) of the preceding Statement, the figures of Col. (2), (4) and (6) of the present one are subtracted, and the sum divided by the figure of Col. 10 of the preceding Statement.

"Everything, down to the conduct of the local agent, can thus be verified. I have always maintained that a balance sheet of a forest can be drawn up as precisely, allowing for the circumstances of the case, as that of an accountant's cash box. Thus I have now an inspecting officer at X, and the register of this forest, states that compartment Ic. contains 6,427 cubic metres, of which 1,523 cubic metres have been already worked out, and therefore there should at the present time be 4,904 cubic metres of standing timber.

"A telegram sent to M. Z......, and tomorrow or the day after, I shall obtain the valuation of what actually remains in the compartment. This system evidently keeps men on the alert. I feel certain that not one of my agents would, even for my own pecuniary advantage, without special orders from myself, venture to execute fellings in places not prescribed by the working-schemes, and thus break the *terms of his agreement with me. Such a measure* would be at once discovered, and men in France are too honorable to break their engagements. I have only to guard against excess of zeal, which often leads my agents to cut too heavily, with the double object of pleasing me, and of increasing my income.

"I always specially compare the figures representing the average price of the cubic metre in my different forests, and endeavour to raise them if possible. Nothing can be more variable; from scarcely 2 francs, which is the value of the cubic metre in some hill forests in the Jura, it varies everywhere up to 20 francs in the forest of X in Luxemburg. The slightest improvement, which can raise the value of the cubic metre by a few centimes, in a forest without export roads, will be followed by a considerable increase in my income.

"Whilst preparing my budget therefore, and deciding as to the amount I intend to devote to improvements, I do not distribute this sum proportionally to the area of the forests—*which would be to* act in the dark—nor in proportion to their cash returns—which would be a false step, and would give the most to the forest requiring the least, but in proportion to the average yield per acre, and to the price in the forest of the cubic metre. I am thus sure of expending capital where it will yield the best return.

"In conclusion, allow me, said M. de N...... to draw your attention to the promptness with which I can answer every possible enquiry you may make *regarding statistical and administrative matters.* What do the forests produce in cubic metres? What is the average value of the cubic metre, at such and such a place, and what is the proportion of timber and firewood which go to form this figure? What is the total original expenditure since such and such a date on works of improvement in each forest? What does the maintenance of these works cost? I can answer all these important questions in an instant, and even if I had twenty or thirty times my present area, I should be just as ready to answer; and in order to do so should only have to produce twenty or thirty simple records."

I could only admit the splendid results of M. de N.....'s system, and thank him for so courteously affording me full information regarding it. His system of managing the hereditary forest estates of his family, is now offered as an object of study to the public.

NOTES FROM REWAH.

(Concluded from page 440).

(Concluded from page 440).

I WILL conclude my notes with a few remarks on the subject of lac. On page 400 of the "Forester," the lac forests were indicated as a separate tract of country. This was incorrect, as the cultivation is not confined to any one particular area south of the Kaimurs. The two trees on which the deposit is chiefly formed are the palás and kosum, *Butea frondosa* and *Schleichera trijuga*, and these two species are reserved as royal woods throughout the State, and care taken to protect them both in *khalsa* and *talúkdári* lands.

But although trees of this species abound in all forest localities, it has been found desirable to restrict the systematic cultivation of lac to four principal districts—*Singrowli, Sohagpur, Chendia* and Singwára. In these four *illáquas* the inhabitants of all forest villages take an interest in the cultivation, and derive a certain amount of profit from it. In parts of Singwára and Singrowli the country has somewhat the appearance of being covered with olive groves, owing to the careful manner in which the palás or chula, as it is locally termed, has been protected, even on cultivated lands. Over considerable areas of country, the fields are divided by borders of these trees, and in very many cases they may be seen dotted about the fields themselves. The cultivation is left entirely to the people, who for many years have been well acquainted with the process, and are thoroughly conversant with the habits of the insect, the method of propagation, and treatment of the trees employed.

The method of propagation is the same in Rewah as elsewhere, and as it has been very fully described already both in the "Forester" and other papers; I shall only note with regard to it that, the people connected with the industry in this State, chiefly Baigurhs and Kôls, recognize a difference or variation in *Butea frondosa* on which by far the greater portion of the lac crop is raised. They divide this species into two kinds, *kála chula* and *safêd. chula*. The former is the one chosen for attention, as the *safêd chula*, although it yields lac, does so in such small quantities as to render its cultivation unprofitable.

I have never been able to account in a satisfactory manner for this distinction. Dr. Brandis, in his *Flora Indica*, gives only one arborial *Butea*, and certainly the two trees here noticed, with one or two slight external differences, are apparently identical in flowers, arrangement of leaves and general growth. But without doubt there is a *Butea* with yellowish white or grey bark, and with comparatively light green foliage, which although found growing with, and under the same conditions as, the commoner, or as common, *Butea*, with darker foliage and greyish black bark, will not yield a lac crop worth collecting, while the darker

hued trees in the same neighbourhood will be covered with the excretion.

I was disposed at first to doubt the above fact, but have become so thoroughly satisfied of its truth that, lately, on the application of a large number of landowners for permission to cut down the white *Buteas* growing in their fields, I have recommended they should be allowed to do so, as the presence of these trees is detrimental to the grain crops, and of no practical benefit for lac cultivation. The explanation that strikes one as most natural, is that, the lighter coloured trees are deficient in sap, and are therefore unable to supply the food demand of the *Coccus* in sufficient quantity to enable it to deposit the excretion; but then if this were so, one would expect to find the light barked variety growing on a different soil or under different conditions to the other, but I cannot say that this is the case, for I have repeatedly observed the two trees growing side by side on the same field boundary, and this not in individual cases, but where trees of both kinds were present in great numbers—the one kind covered with lac, while the other showed scarcely a trace of the deposit.

The chula yields two crops of lac every year. These crops are known locally, and in most lac bazaars, as *bysáki* and *katki*, and are gathered, the first during April and May, and the latter in September and October. The *bysáki* crop is the more useful, and commands a better price than *katki*, which contains a greater portion of colour, a commodity now almost entirely superseded by the cheaper mineral dyes. The lac-bearing chula trees are pruned every third or fourth year, to encourage a flush of new wood, on which the best lac is deposited.

The *kosum* crops, known in the bazaars as *nagoli*, mature in August, September and January; but in this State, the September crop is comparatively poor, and is generally allowed to remain until the following January, when the trees should be covered with a complete crop. Every bit of lac is then pulled off, and the tree, which is now devoid of suitable branch wood, is left for a year to renovate itself with a fresh flush of small twigs, when propagation will be again possible. With regard to kosum lac, therefore, it will be noticed that there is only one commercial crop collected each year, and that each tree only bears this crop in alternate years.

The cultivation of lac was originally commenced in the State by the Agent of a Jabalpúr firm, who set about the work in a very energetic and practical manner, and brought it to a successful and lucrative issue. He commenced by paying the durbar an income of Rs. 500 a year for permission to cultivate and collect the product throughout Sohagpur and Singwara, soon after those districts were transferred to Rewah. This payment gradually increased, until it amounted in 1873 to nearly

Rs. 12,000 a year—Singrowli about the same time being leased out for an annual payment of Rs. 10,000. But in the above year, the price of shell-lac fell so considerably, that the profits derived from the manufacture no longer admitted of keeping up the establishments necessary for controlling the cultivation and collection on a large scale, and so principally owing to this cause, and partly, I believe, to a dissolution of partnership in the Jabalpúr firm, the industry throughout the State collapsed. The propagation of the insect was neglected, and the remnant of lac remaining in the forest was collected later on by a contractor, who having purchased the right for one year only, gathered every morsel of the deposit he could induce the Baigurhs to collect for him. This procedure, as it left no sufficient balance for seed, destroyed the chance of a new crop, and was nearly the *means of exterminating the insect in these forests. In 1880,* when a Forest officer was appointed to Rewah, the receipts from this head had fallen to about Rs. 3,000 a year.

But lac prices having greatly revived, considerable attention was at once directed to this subject; advances were made in large sums to induce the people to re-start the cultivation; godowns were built to warehouse the lac in fifteen or twenty different places, and fairly remunerative rates were fixed at which the lac was to be purchased from the producers. In short, the industry was re-started on the same lines as followed by the original Jabalpúr Agent, and with so much success, that during last year 1882-83, a net revenue of Rs. 52,400 was collected under this head.

Lac indeed is at present the most valuable—or at least the most paying—item of forest produce in this State, where most of the forest areas are too distant or too inaccessible to admit of small wood and bamboos being removed from them with profit. This is especially the case towards the north, owing to the precipitous Kaimur hills; and on the south and east, where the forest country marches with British territory, there is at present an abundant supply of wood in the adjoining country. No income is forthcoming from *the sale of material for local* consumption which passes here duty free; the most valuable of all minor forest produce—mohwa, is also a perquisite of the cultivator; the large timber has been cut down and removed, and considerable forest revenue is already collected through the medium of the Customs Department. Under these circumstances it is not likely that the net forest revenue of Rewah can largely increase for some time to come; and it is probable therefore that the necessity of keeping a Forest officer here will cease as soon as the special areas of forest noticed above in these Notes, have been demarcated and placed under proper management.

J. M.

W. G.

DEODAR IN THE DHÁRA GÁD VALLEY.

THIS valley, about 10 miles long by 4 miles broad, is situated in the hill portion of the Dehra Dún District, known as Jaunsár-Bawar, about 12 miles north of the military station of Chakrata, and about 80 miles in a bee line, also north, of the town of Dehra Dún. The Dhára Gád, a perennial stream, is a tributary of the river Tons, which joins the Jumna at a point where both rivers issue forth from the Himalayas. The highest and lowest points of the valley are respectively 10,075 and 3,037 feet above the sea, but deodar is found only at the head of the valley at elevations above 6,500 feet and distributed in patches over an area of 4,000 acres.

No meteorological observations have ever been made in the valley itself, but the data obtained for Chakrata will give a fair idea of the climatic conditions of the valley itself. The average rainfall and the average monthly mean temperature of the last 13 years at Chakrata (elevation 7,052 feet) have been as follows :—

	Rainfall.	Temperature.
January, ...	1·39	42°·3 Fah.
February, ...	2·59	43°·7
March, ...	3·56	50°·7
April, ...	1·87	59°·9
May, ...	2·99	64°·4
June, ...	7·77	67°·7
July, ...	17·73	64°·8
August, ...	15·49	64°·2
September, ...	5·96	63°·1
October, ...	0·57	57°·8
November, ...	0·25	51°·6
December, ...	1·15	46°·2
Total, ...	61·32	

The highest maximum air temperature often reaches 82°·5 Fah., and the minimum sinks as low as 28° Fah. during the three winter months. The diurnal range of temperature frequently exceeds 30° Fah., and is sometimes as great as 39° Fah.

October and November are fine cold months in the Dhára Gád valley; the nights are frosty, but the frost is probably never very severe. The first falls of snow occur in December, but, as a rule, melt quickly. Very heavy falls are general in January and February. This snow does not, at least within the deodar region, melt until some time in March, and lies in cool shady hollows until even the first week in June. The winter is followed by showery but genial weather through April, May and June, during which period hailstorms are frequent. After this the regular monsoon rains set in and last until the middle of September.

Thus in the basin of the Dhára Gád, as in the rest of Jaunsár-Báwar and in the neighbouring forests on the Tons, deodar affects a climate that is more or less alpine in character. It is first met with naturally at an altitude of about 6,500 feet above the sea, and it disappears only at 9,500 feet, where it yields the place to forest of broad-leaved trees, the chief of which is *Quercus semecarpifolia*. Between these two limits it occupies principally the ridges and dry, well-drained slopes, especially the former. It occurs most abundantly between 7,500 and 9,000 feet.

An elevation of 6,500 feet is, as already said, the lowest point to which deodar naturally descends in the Dhára Gád valley. But that it can flourish and attain useful dimensions at much lower elevations is proved beyond question by the patch of planted deodar, which stands on the site of a *deota* on a north-easterly slope half-way between Kirári and Kistúr at an elevation of about 5,500 feet. As no portion of the forests with

which the present working plan* deals has a less altitude than 5,300 feet, it follows that, provided always that other circumstances permit of it, deodar may be profitably grown throughout the entire area of these forests.

As regards aspect, the deodar in the Dhára Gád valley avoids southerly slopes; but, although it thrives on every other exposure, it is perhaps most abundant and vigorous on slopes facing the north-east. Near its upper limit, however, it confines itself to ridges and the crests of spurs, at those high altitudes the flanks of the ridges and spurs seems to be too cold and damp for the tree, which hence retires before oaks and firs and other denizens of damp and cold localities.

After what precedes, it will be readily understood that deodar avoids the bottoms of ravines and valleys and all similar damp cold places. It requires a well-drained soil, and a certain appreciable amount of insolation. In the valleys and deeper ravines, besides that the sun shines there with less intensity and for a shorter time every day than elsewhere, the snow lies deeper and till a much later period of the year, thus keeping the soil saturated even when there is no rain. These injurious effects of the snow are of course irrespective of the glacier-like movement of the heavy deposit of it in those depressions, which movement is in a general manner fatal to the young growth of all species without exception, but especially so to deodar.

As regards the composition of the soil, deodar is extremely accommodating as long as the drainage is sufficiently free. Making due allowance for that limitation, it may be said to flourish in every variety of soil found in these forests, although it is, as a rule, most abundant on a rich free loam overlying a much crushed or fissured rock.

An analysis of carefully barked deodar wood made at the Central Forest School in 1882, the results of which analysis are published on page 301 of Vol. VIII. of the "Indian Forester," gives the following figures :—

Water in air dried wood, ... 12·826 per cent.

Analysis of ash of steam-dried wood.

Potassium carbonate,	...	0·03 per cent. of weight of wood.
" chloride,	...	trace.
" sulphate,	...	0·02 per cent. of weight of wood.
Phosphates of iron, aluminium, calcium and magnesium,	...	0·05 " " " "
Calcium carbonate,	...	0·16 " " " "
Magnesium carbonate,	...	0·04 " " " "
Silica and impurities, insoluble in acids,	...	0·03 " " " "
Total Ash,	...	0·33

* This paper is extracted from preliminary notes drawn up for a working plan for the deodar forests of the Dhára Gád valley.

From the preceding figures it will be seen that deodar as a forest crop takes away next to nothing from the soil, especially if we exclude calcium carbonate and silica, the quantity of which in the soil of these forests is practically inexhaustible.

In these forests, as elsewhere, deodar is pre-eminently a shade-enduring tree, especially during the first half-century of its life. Seedlings will remain alive under the densest cover for years: the mean age of 10 saplings averaging 7 feet in height and 6 inches in girth at the base, and growing under a complete leaf-canopy, was 39 years. One of these plants, 6½ feet high, was 53 years old! There can of course be no question about these 10 saplings having been prevented by the heavy cover overhead from making anything like their normal rate of growth, yet, in spite of this, the actual rate of growth attained by them under *a complete leaf-canopy compares favorably with the progress* made by 10 seedlings standing out in the open, but in all other respects grown under identical conditions of soil, aspect, elevation and gradient. This second batch of saplings averaged the same girth as the first, but were more than 1½ feet shorter and were older by 5 years. The measurements and ring-countings referred to here are given in detail in the following table:—

Comparative rate of growth of Deodar Saplings grown under heavy cover and out in the open.

SAPLINGS GROWN IN THE OPEN.				SAPLINGS SUPPRESSED BY HEAVY COVER.			
Running number of sapling.	Girth in inches at base.	Height in feet.	Number of rings.	Running number of sapling.	Girth in inches at base.	Height in feet.	Number of rings.
1	6·9	4	51	1	5·5	4½	42
2	5·6	4	41	2	6·3	6	32
3	5·0	6	55	3	5·8	7½	40
4	5·7	7	44	4	5·5	4½	29
5	6·4	8	46	5	6·0	10	42
6	5·8	4	36	6	6·4	9	48
7	5·8	5½	34	7	5·4	6	38
8	6·5	4½	50	8	5·6	6½	53
9	5·5	5	35	9	6·5	10	35
10	5·8	5	48	10	6·0	6	33
Total, ...	59	53	440	Total, ...	59	70	392
Averages,	5·9	$5\frac{3}{10}$	44	Averages,	5·9	7	39

The preceding figures prove clearly that young deodar can not only survive for many years under a dense leaf-canopy, but that a dense leaf-canopy is less hurtful to it than complete exposure to weather influences, the most destructive of which is evidently drought and strong heat, and the weight of superincumbent snow which breaks the leading shoot and bends down and distorts the thin flexible stem. Thousands of vigorous saplings and poles attest the fact that, provided the cover, surrounding and overhead, is not *extremely* dense, young deodar is always able with its long slender graceful leading shoot, to pierce through the overtopping leaf-canopy into the direct sunlight above without suffering any very appreciable diminution of vigour. Hence thinnings made with the object of giving more light and growing room to deodar must be made cautiously and with a sparing hand. No greater mistake could be made than to thin out the forest surrounding or overhead in any wholesale manner.

The conditions under which deodar reproduces itself naturally have not yet been sufficiently studied anywhere. In these forests this study is rendered specially difficult by the fact that in spite of abundant crops of seed at comparatively short intervals, and the absence of forest fires, deodar plants under 10 years of age are remarkably scarce, and recent seedlings, *i.e.*, those which have come up during the last three or four years, are almost entirely wanting, even in places where the ground is free from brushwood or heavy herbaceous growth. No doubt the formation of a thick dense matting of undecomposed leaves and twigs and of herbs and low shrubs, through which matting the comparatively weak tap root of the young seedling has to penetrate before it can enter the true soil, is to a very great extent answerable for this extraordinary failure. But there are no doubt other causes equally important which require careful investigation on the spot through a series of years, and it is to be hoped that they will be thoroughly understood and controlled by the end of the period of five years for which the present working plan is drawn up.

Regarding the rate of growth of deodar in the Dhára Gád forests we possess more certain data. The following table gives, besides the thickness of bark and sapwood, the number of rings per inch of radius counted on 22 type trees. In each tree the rings were counted on a mean radius, the length of which was computed by dividing the sum of the longest and shortest diameters by 4. The thickness of the bark could not be measured in every case, as the bark had disappeared after the fall of the tree.

Ring countings and measurement of bark and sapwood along a mean radius.

Running number of tree.	Number of rings counted on each inch of the mean radius from the centre to the circumference.																		Thickness in inches of	
	1st inch.	2nd inch.	3rd inch.	4th inch.	5th inch.	6th inch.	7th inch.	8th inch.	9th inch.	10th inch.	11th inch.	12th inch.	13th inch.	14th inch.	15th inch.	16th inch.	17th inch.	18th inch.	Bark.	Sapwood.
1	8	6	5	8	5	10	15	14	25	19									..	1·4
2	8	6	7	13	11	11	18	25	18	15									..	1·5
3	6	6	4	4	7	7	6	9	11	19	17								..	1·1
4	8	5	5	5	5	9	15	10	21	21	22								..	1·0
5	5	6	4	7	7	7	7	10	14	14	7	11							0·3	1·3
6	7	5	6	4	5	5	8	10	11	11	16	16							0·4	1·0
7	6	4	4	4	4	5	11	12	22	18	25	24							0·4	0·8
8	9	6	7	8	7	11	13	11	11	14	12	10							..	0·8
9	7	5	5	7	10	10	17	13	16	16	17	17							0·3	0·7
10	8	7	7	8	10	15	17	20	11	12	14	14							0·3	1·0
11	7	4	4	4	4	4	5	8	12	10	21	12	20						..	0·7
12	8	6	6	7	6	9	12	14	16	1.	16	14	11						.	0·8
13	13	7	5	7	10	11	10	12	13	20	17	20	22						0·5	1·4
14	5	4	4	4	6	7	8	7	12	10	11	16	12	14					1	0·9
15	11	13	13	11	8	9	18	11	19	10	10	13	10	24					..	0·8
16	11	7	5	5	7	6	7	8	8	10	10	24	20	25					..	0·8
17	7	5	8	4	4	5	6	6	5	6	7	4	6	7	8	10			..	0·5
18	8	10	5	5	5	4	5	4	5	6	9	4	6	5	7	6			..	1·1
19	7	4	5	4	4	5	8	6	10	8	10	17	15	16	16	14			.	1·1
20	9	7	6	8	6	6	6	7	7	7	10	15	9	18	14	14			0·5	1·5
21	9	7	7	11	19	14	12	8	10	12	6	12	13	18	21	15	18		.	1·6
22	7	5	5	6	6	8	9	9	12	8	9	13	9	12	11	11	12	14	0·4	2·7
Totals,	174	135	125	187	158	177	228	249	288	277	270	250	152	129	77	70	30	14	4	22·7
Averages,	8	6	6	6	7	8	10	11	13	13	14	14	13	14	13	12	15	14	0·5	1

From various observations which it is unnecessary to record, it may be laid down that young self-sown deodar, growing under average conditions in the forest begins to push up rapidly only when it is about 10 years old. In other words, to arrive at a correct estimate of the age of a tree felled at the ordinary height above the ground, we must increase by 10 the number of rings counted on the lowest section. Hence remembering that the average thickness of the bark is ½ inch, we see that the diametral growth of deodar is very slow for the first 10 years, is fairly rapid thenceforward until the 50th year (mean diameter 13 inches), then slackens gradually on to the 70th year (mean diameter just under 17 inches), after which it remains more or less constant up to the 170th year (mean diameter 32 inches), when it declines. A diameter of 2 feet is reached at the age of 120 years, and after this age until the 170th year, the average annual diametral increment is only 0·15 inch. Hence, unless the trees possess exceptional vigour, they would profitably be felled soon after they attain a diameter of 2 feet.

The subjoined table gives the results of measurements taken with the object of ascertaining in a general manner the rate of longitudinal growth of deodar. They bring out an important fact, viz., that deodar continues to grow appreciably in height even after it is more than a century-and-a-half old and has attained a diameter exceeding 2 feet 6 inches.

Measurement of height of Deodar trees of various diameters.

Size class of trees.	Running No. of trees.	Diameter of trees at breast height. feet.	inch.	Height of tree in feet.
Ia.—Trees 3' and upwards in diameter at breast height.	1	3	10	126
	2	3	7⅙	116
	3	3	5⅙	118
	4	3	6	162
	5	3	4⅙	118
	6	3	3	146
	7	3	2	128
	8	3	1	164
	Totals, ...	27	2½	1,078
	Averages, ...	3	5	135
Ib.—Trees from 2' 6" to 3' in diameter at breast height.	1	2	11	119
	2	2	10½	132
	3	2	9	142
	4	2	8	122
	5	2	8	131
	6	2	8	104
	7	2	7½	137
	8	2	7	128
	9	2	7	148
	10	2	6½	139
	11	2	6	151
	Totals, ...	29	4½	1,453
	Averages, ...	2	8	132
Ic.—Trees from 2 to 2' 6" in diameter at breast height.	1	2	5⅓	136
	2	2	4⅓	144
	3	2	4	108
	4	2	4	148
	5	2	3½	122
	6	2	3	127
	7	2	1	132
	8	2	0	121
	Totals, ...	18	1½	1,038
	Averages, ...	2	3	129

Measurement of height of Deodar trees of various diameters—(contd.)

Size class of trees.	Running No. of trees.	Diameter of trees at breast height.		Height of tree in feet.
		feet.	[illegible].	
II.—Trees from 1' 6" to 2' in diameter at breast height.	1	1	11	107
	2	1	11	107
	3	1	11	136
	4	1	10½	119
	5	1	9½	105
	6	1	9	106
	7	1	9	99
	8	1	8½	122
	9	1	8½	157
	10	1	8½	53
	11	1	7	88
	12	1	6	90
	Totals, ...	21	1½	1,259
	Averages, ...	1	9	107
III.—Trees from 1' to 1' 6" in diameter at breast height.	1	1	5	55
	2	1	3½	60
	3	1	3½	60
	4	1	3½	107
	5	1	3	49
	6	1	2½	75
	7	1	2½	57
	8	1	2½	72
	9	1	1½	81
	10	1	1[illegible]	60
	11	1	0	47
	12	1	0	55
	Totals, ...	14	5	778
	Averages, ...	1	3	65
IV.—Trees from 6" to 1' in diameter at breast height.	1	0	11½	47
	2	0	11	53
	3	0	11	48
	4	0	10½	40
	5	0	10	35
	6	0	9½	48
	7	0	9½	44
	8	0	9	51
	9	0	8½	38
	10	0	7½	35
	11	0	6	42
	Totals, ...	8	8	481
	Averages, ...	0	9	44

Putting together the data furnished by the two preceding

tables, and assuming that the number of rings in any half-inch of radius is half the number of rings in a whole inch-length which includes that half-inch (a perfectly reasonable assumption), we obtain the following interesting figures :—

Mean age of trees in years.	Mean diameter of trees in inches.	Mean height of trees in feet.	Mean annual height increment in feet.	Mean age of trees in years.	Mean diameter of trees in inches.	Mean height of trees in feet.	Mean annual height increment in feet.
10	1			105	22		
14	2			112	23		
18	3			119	24		
21	4			126	25		
24	5			133	26		
27	6			139	27	120	0·9
30	7			146	28		
33	8			153	29		
36	9	44	1·2	160	30		
40	10			166	31		
43	11			172	32	132	0·8
47	12			178	33		
51	13			186	34		
56	14			193	35		
61	15	64	1·0	200	36		
66	16			207	37	134 (?)	0·6
72	17				38		
79	18				39		
85	19				40		
92	20				41	135	
98	21	107	1·1				

From the above figures it will be observed that the mean annual height increment is 1·2 foot up to the age of 36 years, falls to 0·8 foot between the ages of 36 and 61 years, rises again to 1·2 foot between 61 and 98 years, and then falls continuously afterwards—to 0·5 foot between 98 and 139 years, to 0·1 foot between 139 and 172 years, and to 0·06 between 172 and 207 years, after which it practically ceases. The sudden rise after the age of 61 years evidently indicates a previous period of suppression, during which the deodar trees were either gradually making their way through the crowns of overtopping firs and oaks, or persisting and slowly pushing up under the diminishing cover of the older leaf-canopy above.

As regards the flowering and fructification of the deodar in the Dhára Gád valley, I am indebted to Mr. Smythies for the following notes :—

"The flowering and seeding of deodar in the Dhára Gád

valley probably follow the same course as in other parts of Jaunsár. Near Deoban, I have observed that the pollen shower takes place in October, and the female flowers are then fertilized; they are very small at that time, but about a month later, in November, they appear as soft, oblong, bluish-red cones, one-third to half an inch long. In December they become firmer and greenish in colour, but still remain very small. In the following April, the cones are as large as small walnuts, and increase rapidly in size during May-August.

"In October-November, the cones are brown and ripe, and shed seed copiously. In other words, it takes exactly twelve months from the fertilization of the female catkin to the shedding of the ripe seed.

"Deodar seed is not formed every year in large quantities. The following were specially good seed years in which every fertile tree seeded and enormous quantities of seed might have been procured:—1872, 1875, 1878, and 1881. In intermediate years it is generally possible to procure seed from scattered trees, but the amount procurable is never large, and the quality is not always good.

"A pound Avoirdupois contains about 3,500 seeds. A good seed should be full of transparent liquid resin, and in the centre the first bundle of yellowish-green leaves should be distinctly visible." Mr. McDonell gives for deodar seed in Kulu in the Punjab 2,800 to the pound.

(*To be continued*). E. E. FERNANDEZ.

NOTES ON FRENCH FORESTS. BY MR. A. SMYTHIES.

The following paper has been received in India from the Secretary of State, and is circulated by the Government of India to all Local Governments. The information it contains will be very useful to any Indian Forest Officer, who may wish to visit the French Government Forests:—

Strasburg.—The forest of Strasburg, or the Hohwald, is situated on the eastern slopes of the Vosges mountains, in what was formerly the Department of the Lower Rhine, and it nearly surrounds the small village and watering place called Hohwald. It belonged formerly to the Commune of Strasburg, but since the Franco-German war of 1870-71 it has been considered State property, and it is managed like other Crown forests in Germany.

The area of the forest is 2,116 acres; the total annual yield is 229,580 cubic feet, or about 108 cubic feet per acre; the total annual revenue amounts approximately to £3,600, or about £1, 12s. per acre; and the expenditure amounts to £800 annually.

This is a most instructive forest to visit, owing to the splendid natural reproduction of the two principal trees, and the

regular young crops which have resulted from the regeneration cuttings themselves. Silver fir and beech constitute the greater proportion of the standing crops, and it is now many years since the regular method of compartments, as distinguished from the selection method, was first applied. There are some portions of the forest, however, where the young beech poles have been allowed to overtop the silver fir, and though the latter has a wonderful faculty of shooting up and growing vigorously after many years of suppression, it is nevertheless obvious that had the beech been cut away some years previously, the silver fir would be now much higher, more vigorous, and more uniform; in other words, the absence or neglect of *cleanings* has here most certainly resulted in a loss of production and of revenue, for the fir is far more valuable than the beech. These remarks, however, are applicable only to a small extent of forest, and in the younger seed crops the beech is being cut away in time, and the fir will be able to shoot ahead from the beginning. The necessity of cutting back the beech in a mixture of silver fir and beech is explained on pages 81 and 82 of the "Elements of Sylviculture."*

A comparison between the conditions of growth in the forest of Strasburg and in the fir forests of the North-West Himalayas is in many respects in favour of the former. The slopes are less steep, so that you can walk up and down with the greatest ease, and they are not so rocky; the soil is deep and always moist, there is a conspicuous absence of under-growth (shrubs, bushes, herbaceous plants), and seedlings are found everywhere under any crop which is sufficiently advanced to shed seed copiously. The main conditions of natural reproduction by seed are therefore different in the two countries, and this should be borne in mind whenever fellings are made in the Himalayan fir forests. A certain strip of forest near the village of Hohwald was entirely cleared by the wind some years ago; it has re-seeded itself, and now bears a dense young crop of fir and beech; such a result would only be seen in the Himalayas under exceptionally favourable circumstances, and even on the limestone soil of the Jura, where brambles and other plants grow up in a thick mass as soon as they receive sufficient light, such a spot would have to be planted up.

There are various plantations of spruce fir, belonging to private owners, in the Hohwald, the thinnings from which yield valuable returns as hop poles. The forests between Saverne and Schlestadt are well worth visiting, and Wasselonne is said to be as good a forest centre as can be found throughout the Vosges.

Gérardmer.—Gérardmer, in the Department of the Vosges,

* "The Elements of Sylviculture," by G. Bagneris. London, Wm. Rider and Son, 14, Bartholomew Close, 1882.

may be reached from Epinal by rail, or from Munster by diligence. The State forest, surrounding the fashionable watering place of Gérardmer contains 11,472 acres, and is divided into eight working circles, of which six are treated by the regular method, while two are worked on the selection method, owing to their being at a considerable altitude near the limit of forest vegetation. The rock is granite, and the altitude varies from 2,000 to 3,800 feet above sea level.

The average composition of the forest is as follows:—Silver fir, 40 per cent.; beech, 30; spruce fir, 20; other kinds, 10. Here, as elsewhere, the two firs are the important species and command the highest prices.

The average annual yield for the whole forest is not more than 50 cubic feet per acre, and the revenue for 1882 amounted to £7,448, or about 12*s.* 9*d.* per acre. Some of the working circles, however, show slightly better results than this; for instance, the eighth working circle, called *la Grande Montagne*, has an area of 1,868 acres. The annual yield of regeneration cuttings in the first block is based on volume, and it has been fixed at 84,768 cubic feet, or about 45 cubic feet per acre. In this amount are included all windfalls and dead trees of 3 feet girth and over, and all trees of 4 feet girth and over, removed in thinnings, selection fellings, &c., in the remaining blocks which have not yet reached their turn for reproduction. This leaves a small amount for thinnings of smaller poles, windfalls, and dead trees under 3 feet girth, throughout the working circle, but it cannot be estimated at more than 10 cubic feet per acre, making the total annual yield 55 cubic feet per acre. The revenue from this working circle for 1882 amounted to £1,367, or about 14*s.* 8*d.* per acre. The working circle *la Grande Montagne* is well worth visiting, owing to the regular distribution of age classes on the ground, and favourable reproduction; but the yield and the revenue (if the figures given above, which were furnished by the local forest officer, fairly represent the average of a series of years) are remarkably small, and in this respect this forest compares unfavourably with other forests in the Vosges. The rotation on which this circle is worked is 144 years, divided into four periods of 36 years each, to each of which a block of an average area of 467 acres has been assigned. There are four Government saw mills in the locality, besides numerous private ones, and as a rule all the firs are cut up into planks on the spot. The total length of forest roads is about 42 miles. Gérardmer is well known to all forest officers who have passed through the school at Nancy, as every year the students are taken there to undergo a course of triangulation and to be instructed in the working of saw mills, of which there are many kinds within the vicinity.

Pontarlier.—The communal forest of Pontarlier is situated near the town of that name, on what is called the second plateau

of the Jura mountains, consequently on the Jurassic limestone, and at an average altitude of 2,500 feet above the sea level. The first working circle has an area of 574 acres, and the average annual yield is about 79 cubic feet per acre, including thinnings and selection fellings. These limestone soils are rich, and there is a great variety of under-shrubs in this forest, including three species of *Lonicera* and a herbaceous elder. If too much light is admitted on to the ground before the crop of young seedlings is thoroughly established, a dense crop of brambles springs up, chokes pre-existing seedlings, and renders natural reproduction slow and uncertain, if not altogether impossible. The third block of this working circle is chiefly remarkable for a regular and complete pole crop of silver fir, 60 years' old; the leaf canopy is complete, and there is scarcely any herbaceous vegetation on the ground. This portion of the forest is the more interesting as the reproduction cuttings which resulted in the present excellent crop were made in 1820 by M. Lorentz, one of the founders of modern French sylviculture, and now Director General of the Forest Administration.

One circle is worked on the selection method, on account of the steepness of the slope, thus resembling in some of its features a Himalayan forest.

La Fuvelle.—This forest derives its name from *fue*, an old word for *épicea*, the spruce fir. It is situated on the third, or highest, plateau of the Jura mountains, at a mean altitude of 3,280 feet above sea level. The total area is 366 acres, and the forest is worked on a rotation of 140 years, which is divided into seven periods of 20 years each; there are consequently seven blocks containing on an average 52 acres each. The second period commenced in 1878, so it is in the second block that regeneration cuttings are now being made. In the first block, which was regenerated from 1858 to 1877, thinnings have already taken place once.

The crop consists of spruce and silver fir in almost equal proportions, and here it is the former which is the more valuable, the spruce having a value of about 7*d.* a cubic foot for standing timber, whereas the silver fir is not worth more than 5½*d.*

The soil is not deep, and the trees do not attain a greater length of timber than 80 feet; but for all that, the forest has been so carefully organized and managed, that the returns are remarkably good considering the great altitude. The average annual yield, taken from the figures for the last 25 years, amounts to 49,229 cubic feet, or about 135 cubic feet per acre; the average annual revenue during this period amounts to £928, or £2 10*s.* 8*d.* per acre; while the expenditure has not been more than £40 per annum, excluding the proper share of pay of the superior officers; this would not, however, raise it to any considerable extent, and there remains a handsome net annual revenue to the State.

In the second block, where reproduction fellings are now going on, we find numerous young seedlings of the two firs in the most promising condition; many of them existed on the ground before the primary cutting was made (*advance growth*), and are now profiting by the extra amount of light given to them; the soil is not deep, and consequently there are no brambles or brushwood to interfere with reproduction, and the thin covering of moss on the ground, permits the seed to germinate with great facility. The crop is aged from 140 to 150 years, as shown by the annual rings, and the trees have a mean girth of 6 feet at a height of 5 feet above the ground.

The third block shows a dense crop of tall timber, with much young growth of various sizes underneath; here and there the wind has blown down some of the taller trees, but generally speaking the forest of *la Fuvelle* seems to be singularly free from the ravages of the wind. This is not the case with all forests in the locality, as there is a forest higher up the valley where 5,000 trees were blown down in a single day, stopping all fellings for two years, greatly interfering with the nice calculations of the annual yield, and of course seriously compromising reproduction, for it is not every forest where one may expect such a favourable issue as that mentioned under the forest of Strasburg.

In the fourth and fifth blocks the trees are somewhat smaller, and the sixth and seventh have been already regenerated. Selection fellings are carried out in the third, fourth, and fifth blocks. In the seventh block we find a complete and regular young crop, 30 years old, growing up under the best possible conditions, with rather more spruce than silver fir. The average height of the poles is 35 feet, and their girth 4½ feet.

This most instructive forest is well worth a visit, as all the details of the organization project (which for this forest was prepared by M. Ch. Broilliard) can be the more readily appreciated by the beginner, as there is only one working circle, and the various age classes are very fairly represented.

La grande Côte.—The neighbouring forest of *La grande Côte* is situated on the other side of the valley at about the same altitude. It contains an area of 947 acres, and is worked on a rotation of 150 years; it forms one working circle, and is divided into five blocks, with five periods of 30 years each. The first period commenced in 1858, and is consequently approaching its term. The conditions of growth are much the same as in *la Fuvelle.*

The average annual yield, taken from the returns of the last 25 years, amounts to 104,636 cubic feet, or about 110 cubic feet per acre, and the gross annual revenue has amounted on an average to £1,970, or about £2 1s. 7*d.* per acre, while the expenditure—omitting as before the pay of the superior officers—has not exceeded £80 per annum.

Levier.—The forest of Levier is situated on the gentle

slopes which descend from the second plateau of the Jura to the first plateau. It is distant about 16 miles from Pontarlier, and is in the conservatorship of Besançon, and the department of the Doubs. The mean altitude may be put down at 2,500 feet above sea level.

The *geological formation* is the Jurassic limestone.

The area of the forest is 6,734 acres, and it is divided into eight working circles, and the transitional rotations adopted in them vary from 80 to 120 years, but when the forest has been finally reorganized as high forest, worked by the regular method of thinnings, the rotation will be uniform and fixed at 160 years. There will also be a smaller number of working circles.

As an instance of the present organization of the forest, we may take the second working circle, called *Grand Jura Ouest*. The area is 623 acres, the rotation is 100 years, and there are five blocks, with five periods of 20 years each. The annual yield of the principal cuttings is drawn from the second block, together with some old trees remaining in the first block, and it has been fixed at 44,933 cubic feet. In the third and fourth blocks selection fellings are made, and they extend over one-fourth of the area every year; in the first and fifth blocks improvement cuttings are made over about one-tenth of the area every year, so that any one part is re-visited every four years in the first, and every ten years in the second, case.

The *following figures* have been compiled from an elaborate return furnished through the kindness of M. Cardot, the Inspector of Forests at Pontarlier, and, as they embrace a period of two-and-twenty years, they may be relied upon as correct, and adapted to show the true financial state of one of the best State forests in France:—

Average of the 22 years 1861 to 1882 inclusive.

Annual yield of all fellings, ... 1,125,186 cubic feet.

		£
Value of this yield (gross revenue), ...	...	22,252
Expenditure (not including a share of the pay of superior officers), ...	...	468

Reducing this to the acre, we find that the annual yield amounts to 166 cubic feet, and the gross revenue to £3 6*s.* 1*d.*, a result probably unequalled in any other forest in France. If we allow a large margin for the proper share of the pay of superior officers, we shall find that the average *net* annual income to the State amounts to *three guineas an acre*.

The crop consists almost entirely of silver fir, which, in

this forest, attains its finest dimensions, as the following measurements will show:—One tree was 13 feet in girth, at 5 feet from the ground, and was 155 feet long, taking in all that could be sawn. Another tree, blown down by the wind, measured 146 feet long, and roughly squared at the base, girthed 10 feet. Many trees standing had a girth of 10 feet and over, and as a rule logs are drawn out of the forest 80 to 120 feet long. There are large steam saw mills in the vicinity of the forest, and these logs are drawn out by bullocks in their entirety, so that they can be sawn up to any required scantling. In the Vosges the logs are scarcely ever more than 18 feet long, as that is the usual length of the planks required for the market. There is thus in the Vosges forests very little damage done to the young crops, whereas in the forest of Levier the injury caused to young saplings and seedlings is enormous. It is especially at corners and turns in the road that the chief mischief is done, for as the log sweeps round, it smashes and destroys all the young trees with which it comes in contact.

The wind is the most dangerous element the forest officer has to contend with on this exposed plateau of the Juras. In the 8th working circle, a large space containing over 200 trees was cleared by the wind in 1880, and the soil is now covered with turf and brambles. The crop was a dense high forest, about 170 years old. There were very few seedlings underneath, and now the whole area will have to be planted up with some difficulty, as silver fir does not come up well in the open. Even in conducting the regular cuttings great prudence has to be exercised, as, if too much light is admitted, the rich soil gives birth to a dense mass of brambles and herbs, which greatly impede the growth of seedlings, if they do not entirely prevent it. Similar results, only on an exaggerated scale, may be seen in the silver fir forests of the North-West Himalaya, where, even under the densest canopy of mature trees, the undergrowth of herbaceous plants is so thick that seedlings establish themselves with difficulty, and the evil is made worse when more light is admitted.

Forest officers on leave from India should be recommended to pay a visit to the forest of Levier, as there is much to be learnt in every way from a careful inspection of this splendid forest; and if ever a Forest School is created in England, and the students are taken abroad to study continental methods of forestry, they would do well to direct their steps to Pontarlier, and make themselves thoroughly acquainted with the silver fir forests of the second plateau of the Jura mountains.

La Joux.—The forest of *La Joux* touches the forest of Levier on the south, and in reality forms one continuous forest, only it is in a different department and in a different conservatorship. Its area is 6,543 acres, and it has a mean altitude of 2,625 feet above sea level. The forest is divided into five working circles as follows:—

Name.	Area in acres.	Rotation years.	Annual yield. Total.	Annual yield. Per Acre.	Remarks.
			c. ft.	c. ft.	
Northern, ...	1,589	160	120,688	76	The annual yield is simply that of the regeneration cuttings in the first and fifth blocks.
North-Eastern,	899	160	78,797	88	
Eastern, ...	1,237	140	143,470	116	
Southern, ...	1,213	140	109,815	90	
Western, ...	1,605	140	142,198	89	
Total, ...	6,543	...	594,408	90·8	

To this annual yield of 91 cubic feet from the regeneration cuttings in the first and fifth blocks, we must add that which results from thinnings and selection fellings in the other three blocks. This may be estimated at 45 cubic feet, and we thus obtain a total annual yield of 136 cubic feet per acre.

The total gross revenue is now £16,000, or about £2 8s. 11*d.* per acre. It was formerly as high as £20,000, but the price of wood has gone down. The expenditure may be estimated at £800, or about 2*s.* 6*d.* an acre, leaving a handsome net income to the State, though it does not come up to that of the forest of Levier. The conditions of climate, aspect, growth, export, &c., are very much the same in the two forests, and it is not easy to understand why there should be so much difference in the revenue and in the yield.

La Fresse.—The forest of *La Fresse* adjoins the forest of La Joux, with an area of 2,820 acres. The crop consists principally of silver fir, but this tree does not attain the same dimensions here as in the forest of Levier, and the yield and the revenue are much less.

Chamonix.—The communal forest of Chamonix is situated on both sides of the valley, and chiefly between that place and Argentière. The area is 2,750 acres. It is composed almost entirely of spruce, fir, and larch, and is worked by the selection method. Any other method of treatment would be here quite out of the question. The higher parts of the forest are at the limit of tree vegetation, and the extreme rigour of the climate, combined with steep and rocky slopes, render reproduction difficult and uncertain; seedlings of larch and spruce, however, are not wanting whenever the light and the soil are suitable. There are but few large trees remaining in the forest at the present time, and the spruce seldom attains a larger girth than 6 feet, while the larch is found 8 or 9 feet in girth.

The annual yield was estimated at 35,300 cubic feet, or

about 15 cubic feet per acre, but these figures must be accepted with some reserve; still there is no doubt that the yield of forests so high up cannot be compared with that of forests lower down and on more fertile soils. It may be as well to state that the revenue of this forest cannot be given, as the timber cut annually is divided among the inhabitants of Chamonix, who either sell their share or use it up for their own requirements. The value of the cubic foot of spruce standing in the forest is about threepence, while that of the larch is almost double.

TIMBER TREES FOR SINGAPORE.

The Government of the Straits Settlements has recently indented on the Government of India for a supply of seeds of various Indian timber trees. Sir F. Weld, the Governor of that Colony, intends to make experimental timber nurseries at or near Singapore, and the list of trees, amounting to nearly 50 kinds, includes most of the common timber trees, such as sál, sissú, chir, pine, the terminalias, tún, ebony, and others, but strange to say omits teak. Where it is thought that seed will not survive the journey, it is suggested that Wardian cases should be sent; but we fancy that the estimated cost (about Rs. 500) will not allow many Wardian cases to be sent, as they are rather expensive articles. The amount of seed asked for is more than 12 maunds. While admiring the energy of Sir F. Weld in endeavouring to procure good timber trees for Singapore, we should like to know more about the natural resources of the colony in that direction before awarding high praise to this measure, as the first step in rational forestry is to husband and utilize the indigenous material of the country. We hope to be able to place some account of the forests of Singapore before our readers at an early date.

S.

V. Notes, Queries and Extracts.

GUSTAV HEYER.

To-day we have the painful duty of communicating to our readers the death of Geheimer Regierungsrath Dr. Gustav Heyer, Professor of Forestry in the University of Münich in Bavaria, which took place on the 10th July last. Dr. Heyer was passionately fond of fishing in his leisure hours, and it was while thus employed, that he succumbed to heart disease.

Gustav Heyer, who was born in 1826, was descended from an old Forester's family, his father having been the well known Professor of Forestry and Author, Dr. Carl Heyer, whose Handbook of Sylviculture is at the present day still the leading work on that branch of forestry. He left the higher Grammar School, with excellent testimonials, at the age of 18, and he devoted the next four years (1843-47) to the study of forestry and the allied sciences in the University of Giessen in Hesse Darmstadt. From 1847 to 1849, he was employed in the Hesse Darmstadt Forest service, and in the latter year, he established himself at Giessen as a teacher of forestry. In 1853 he was nominated extraordinary, and in 1857, ordinary Professor of Forestry and Director of the Forest School attached to the University of Giessen. From 1854 to 1857 he was also an Oberförster in the service of Hesse Darmstadt, and in charge of the forests in the vicinity of Giessen.

Heyer remained at Giessen until 1868, when he accepted the position of Director of the new Prussian Forest Academy at Münden, which he lost no time in bringing into a most flourishing condition. In 1878 he became Chief Professor of Forestry in the University of Münich, where is now the most eminent School of Forestry in Germany, and we may add in the whole world. From 1857 to 1878 Heyer was the Editor of the Allgemeine Forst and Jagd Zeitung, the leading German Journal of Forestry.

Heyer was a most brilliant lecturer, who understood thoroughly how to carry his pupils with him, and this was to a great extent due to his being a most highly educated man, free from all prejudices of his special calling.

He was not only a good classical scholar, but he was also most thoroughly at home in all the different branches of Physical Sciences, Natural History, and in Mathematics, and he

was specially strong in Chemistry, which he had studied under Liebig. When we add, that he was a most kind-hearted man, who knew no greater pleasure, than to help and oblige others, it will readily be understood, how devoted his pupils were to him.

Gustav Heyer is the author of many important works in the different branches of forest science, as "Calculation of the Contents, Age and Increase of Forests" (1882); "Light and Shade in reference to Forest Trees" (1852); "Soils and Climate in reference to Forests" (1856); "Determination of the value of Forests" (1865, 1876 and 1883), which has been translated into the Spanish, Italian, Russian, Croatia and, it is said, Hungarian languages; "Forest Statics" (1871). He also brought out new editions of his father's works on Sylviculture and on Working Plans, and he has contributed numerous articles to forest periodicals.

It may safely be said that Heyer was to Forestry, what Liebig was to Agriculture. His great object as a teacher was to stand up for the education of Forest Officers at Universities, and to base Forestry on the teaching of the exact sciences.

Gustav Heyer had the satisfaction of being appreciated during his life time. Honors were showered upon him, and he received the most brilliant offers from various Governments, but he preferred to devote himself to the teaching of the science he loved so well. By his untimely death we have lost the most brilliant leader of Forest Science of the present age.

A FEW NOTES UPON MASTS.—In writing upon the subject of masts, the first question that presents itself is the origin or meaning of the word. We find it as "mast" in the English, Dutch, German, Danish, Prussian, Swedish, and Norwegian languages. It may thus be said to be a word peculiar to the Teutonic people. In all cases it is found as a noun, and it refers to the mast of a ship. We need scarcely say that it is allied to, and associated with, the word "spar," and that a mast is neither more nor less than a great spar. The word "spar" is still used in connection with small masts of vessels, and with scantlings, or rafters, for the roofing of houses, from the fact that until late years the latter were formed of round or squared poles.

The primitive of "spar" is "spear," a long shaft or warlike instrument; any straight piece of wood in the form of a spear would thus become a spar, and according to its size it would be a great spar or a small spar.

Our Teutonic ancestors' equivalent for great was "mycel," a word that still lingers in Scotland as "mickle," and one that is still found in place and local names in England, as in "Micklegate Bar," in York. A great spar would thus be referred to as a "mycel-spar;" but if it were required to be intensified as "a

very great spar," the superlative of mycel, viz., "máest," would be used, and hence the "máest-spar," the primitive of mast-spar, would mean the "greatest spar," or the "spar of the first, or chief magnitude."

It is highly questionable whether Milton, with all his learning, ever had the means at his command for working out the etymology of this word; but it is, to say the least, remarkable how close he runs upon the line of it in his sublime description of Satan, in his first book of "Paradise Lost." He associates the spear with the mast, and describes the largest mast then known to him as but a wand compared with the spear of Satan.

We give the quotation; for Milton's lines, like fir trees in a landscape, are never out of place:—

> "His spear, to equal which the tallest pine
> Hewn on Norwegian hills to be the mast
> Of some great ammiral,* were but a wand."

As time wore on, the descriptive term "máest-spar" underwent the process of clipping or abbreviating; the noun "spar" was dropped, and the adjective "máest," in the corrupted form of "mast," took up its place, and thus became a noun-substantive.

Transformations of this kind are not peculiar to old times, as is proved by a parallel instance in our day. An engineer of the name of Outram invented iron roads, which, after him, were termed "Outramways;" this term quickly changed to "tramways." The carriages running on these ways became "tram-cars," a term that our American cousins soon dressed down to "trams." Thus we see how a portion of a man's name has become in one generation the noun-substantive for an omnibus.

We will now turn from these vagaries of our language, which, to say the least, are interesting, and touch upon the early history of masts.

As the modern "sea kings" we have more to do with masts than the people of any other nation, and in turning back the pages of history, we must look for their early use where we look for our ancestors, viz., in the old "wics," or bays of Scandinavia, and the southern ports and creeks of the Baltic, for it is there we find the early home of shipbuilding.

Those countries are peculiar to this important trade; they naturally produce the oak and fir for the hull of the ship, the spars for the masts, the tar for the paint, the hemp for the ropes and oakum, and the flax for the sails, and, lastly, in the stump of the fir tree, with its spreading prongs, they furnish the primitive anchor. The trade of shipbuilding was planted in England by those Northern settlers, and the material for conducting it has, more or less, been drawn from these old quarters, down to the present day.

The forests of England have given us a great store of ship-

* An obsolete form of "Admiral."

building wood in the form of oak; but whether they ever produced fir trees suitable for conversion into masts is a question of very grave doubt.

We have, on the other hand, evidence of masts and spars being largely imported into England in the middle ages, and we have copies of bills of entry before us which reach back into the past for nearly 500 years. We glean from Frost's "Early Notices of Hull" that the ship *Maudelayne*, Captain John Hogge, of Newcastle-upon-Tyne, was entered for Hull on the 28th of May, 1400. She had as a cargo 2,000 spars of firwood, 200 fir planks, and eleven masts. The goods were returned as the property of the captain of the vessel, the value of the taxable portion being £4 5*s*., and the custom, or duty, 2*s*. 10*d*. From this we learn that the captain was working the ship for one of the old merchant adventurers of Newcastle-on-Tyne. We are not informed of the port the goods were shipped from, but from the time of the year, "May 28th," we may safely set it down as the Baltic. On the 2nd July, in the same year, the ship *Marieknyght*, Captain Jacob Thurston, of Aslowe, arrived. The captain had as part of the cargo a "spar of fir mast." From his cargo being principally elk and martin skins, beast and sheep skins, butter and bacon, we may take it for certain that he was from the Baltic.

We see from Milton that the opinion in his time was that the masts of ships came from the hills of Norway. It would appear that a considerable trade was done in spars from that country, and judging from the fact that those shipped at the present day are whitewood, the inference is strong that those of old were of the same wood, and this opinion is strengthened by the fact that the spruce fir is there larger, straighter, and less tapering than the redwood. There is, of course, the question of durability, which to a great extent is balanced by its lightness. It is a known fact that the Romans used the trunks of the "silver fir" for their masts, its quality of lightness outweighing all other considerations. Be this as it may, it is certain in more modern times that redwood has been preferred, and in this wood Norway has never been able to compete with Poland and the south of Russia. It is to Dantzic and Riga that we must necessarily turn for our best notes in connection with the old mast trade.

The growth in the size of the ships of France and England, more especially in the navy, led the merchants to search about for gigantic trees. The masts of Norway could not be supplied in redwood, of larger size than 18 in. at the butt, and of these the supply was very limited. Hence this shipment was understood to be a small one, and the "Norway mast" is still the trade term for small masts. Dantzic and Riga took up the trade, and furnished masts of 18 in. to 25 in. diameter, thus beginning with large masts where the Norwegians left off. The Dantzic shipments, although highly prized, were not considered so fine

as the Riga, nor do they appear to have formed so special a branch of trade. Their finest trees came from the forests of Poland, and the lands bordering on the south of Russia, from whence the logs were rafted down the Vistula to Dantzic. Arriving there, the best and straightest were cut and trimmed for masts. The second quality logs were cut up for deck planking in average lengths of 33 ft., and in thickness 4 in., 3½ in., 3 in., and 2½ in., the width invariably being 9 in. In some cases the very largest masts were dressed up with the axe into an octagon form.

The mast trade has been best developed in Riga, and hence the name of this port became associated with the best and finest wood in Europe. The great forests in the sandy districts of the Dwina were searched for the finest and straightest trees, which, upon being felled and found to be sound, were sledged to the waterway, and floated down to Riga. Such was the price obtained for these masts from the Royal Dockyards of England and France, that the merchants of Riga sent out experts to search for new supplies in the valley of the Dnieper, and this river was followed through the most fruitful districts of Russia towards the shores of the Black Sea. Upon suitable trees being found they were conveyed to the river and at great cost hauled up the stream to a certain point, whence they were conveyed overland, a distance of twenty-three miles, to the banks of the Dwina, and floated down to Riga. A great trade in wood is still done on this route; but the land carriage has given way to that of a canal, which has worked wonders in the development of the trade of Riga.

The arrival of these masts in Western Europe caused great surprise, as trees of that magnitude were wholly unknown in the temperate regions of France and England, and with the French, who were not such lords of the ocean as the English, a desire originated to foster the cultivation of such trees in the woods of France. On this point we have somewhere read of a commission being sent out to the Russian forests to collect the seeds of these "mast-trees," and to plant them, on their return, on French soil. The result was a plentiful growth of the common Scotch fir *(Pinus sylvestris)*, and the purchase of the knowledge that their enormous size in the south of Russia was the accident of soil and climate.

During the last half century a great change has come over the spirit of the mast trade; the high prices and ready sale of those from Riga fostered enterprise on the part of the English people whose lot had been cast in the forests of the New World. Log by log, the strange but gigantic trees of Canada, the United States, and Australia, were introduced to the English dockyards, and little by little the old trade of Riga has been undermined, until, as in the present day, the shipbuilders of this great country are practically independent of the old Baltic ports.

In the "fresh fields and pastures new" thrown open to the

mast trade, the fir, from its height, its straightness, and its lightness, in one variety or other, is rigidly adhered to. Roughly speaking they may be classed under five heads, viz., 1, Quebec yellow pine; 2, Quebec red pine; 3, United States pitch pine; 4, Oregon pine; 5, Kauri pine.*

The yellow pine has been fairly used and tried: but being soft, easily broken, prone to decay at the level of the deck, and what is of the greatest consideration, very costly, it is now but sparingly used.

The red pine, although a fine-grown tree, is rarely sufficiently straight for the purpose of masts, and in consequence is but little used.

The pitch pine may to-day be termed the true "mast-tree;" it has all the requisite qualities for this purpose, but its weight is a great drawback, and it is not considered as a very durable wood. These objections are more than compensated for by its cheapness, and the clean, sound character of the wood; and hence in almost every shipyard in England it is more largely used than any other pine.

The Oregon or Douglas pine ranks, from its great size, as the first of the mast-trees. It is grown in the forests of North-western America, a quarter of the New Continent that has shown us examples of colossal trees, the like of which was previously unknown to the world. These masts are sent to us in a hewn form, faultless on every point. This wood, from the cost of transit, cannot be brought into competition with other shipments; but where size is a consideration, it carries all before it, as masts of 110 feet in length, and 32 inch diameter are by no means exceptional. The curious on this point will be pleased to inspect the celebrated flag-pole in the Royal Gardens of Kew, which is an example, 159 feet in length and of proportionate thickness.

The Kauri pine ranks with the Oregon pine in being a monarch of the forest. This is otherwise known as the Australian pine, or Norfolk Island pine. Its quality for masts is everything that can be desired, and although its cost is very great, owing to the excessive sea carriage, it is by no means a rarity in this country. Some years ago the Governor of New Zealand sent a gigantic mast to the English Admiralty, and a friend of ours, who was a passenger home with this tree, says that it was lashed to the masts and bowsprit, and projected 30 feet over the head and stern of the ship. It was found to be highly suitable for masts and spars, and a commission of experts from the dockyards was afterwards sent out to examine and report upon the Australian forests.

A tree of this class was felled on a farm near the Maharangi River, intended for the 1851 Exhibition in London; but, the time allowed for transport being too short, the project was abandoned, and the tree was left upon the ground. The length of the

* 1, P. strobus; 2, P. resinora; 3, P. rigida; 4, Pseudotsuga Douglasii; 5, Dammara australis.

bole, up to the branches of the bushy head was 100 feet, and its diameter at the butt was 10 feet. Laslett mentions a still larger tree, which measured 80 feet to the branches, and 24 feet in diameter.

About fifteen years ago a parcel of 60 logs arrived in Liverpool on consignment to Mr. Edward Chaloner; we were told they averaged 90 feet in length, and squared up to 3 feet, and that they were perfectly clean and sound.

It would appear with the mast trade, as with many other industries, there is a constant thirst for change; the latest fashion is the construction of the lower masts and the principal spars of wrought iron, a system that places, for once in the career of English shipbuilding, the growth of our masts in our own hands.

The objection taken is that they are heavy, and in case of disaster they cannot be felled and thrown overboard; but this appears to have little consideration, for the manufacture of tubular iron masts is becoming very general, and to-day there are few of our first-class ships but what are so fitted in their rigging.

Such, then, are few of our notes upon the subject of masts, and we may venture to remark, if they serve no other purpose, they will go far to prove that, in searching into minor details of the trade, we find in them "more than is dreamt of in our philosophy."—*Timber Trades Journal.*

MATCHES.—Few if any people who are daily in the habit of using matches have ever thought how much of ingenuity and skill are expended in their manufacture, says an American contemporary. Yet the extent of the match timber, or, as it is termed, lumber manufacturing business, in the United States and Canada, may be fairly realized when it is stated that one match manufactory alone paid 4,000,000 dols. in taxes during the year ending December 31st, 1881, being at the rate of one cent per box. That is, the manufactory had produced in one year 400,000,000 boxes of matches. The logs are bought in the first instance by the owners of one of the numerous saw-mills to be found upon the River St. Lawrence and its tributaries; and the millowner distributes the lumber after it is cut. The wood used is pine and spruce. The match-lumber factory is divided into departments, in which are manufactured match-boxes, cases called skillets, match-sticks called splints, and the round wooden match-boxes, which are less used now than formerly. Match-boxes are made from a square piece of wood, by one turn of a machine which consists of two collars, a borer, and a side-saw. This machine makes twelve boxes and twenty-four lids per minute out of a piece of wood an inch and three-fourths square. When the box and lids are made in the rough, they are placed together in a hollow roller, which is revolved by water-power, and in this way the defects are removed, and the whole box is made beauti-

fully smooth, owing to the friction created within the wheel. The match-sticks, or splints, are cut double the length of the ordinary wooden match, and when sent to the match manufactory they are dipped at both ends, and cut in the centre when dry. These splints are made from solid blocks of wood, which have been previously steamed, by a machine which makes from twelve to eight sticks at a blow, and all the blocks are three inches square. In a day of ten hours no less than 46,000,000 splints are made at Fitch's factory.*—*Timber Trades Journal.*

TIMBER AND EARTHQUAKES.—Consul Denius, in his annual report, says:—Wood for the construction of houses is an important item among the imports of Smyrna, as the houses of the lower orders are built entirely of wood; and those of the better class, which outwardly appear to be of solid construction, have skeletons of wood merely faced with stone—a system adopted to lessen the danger arising from earthquakes. Both timber and planks come chiefly from Austria, Russia, Roumania, and European Turkey. In 1877 the import was confined to planks, which accounts for the small import of that year, amounting only to £11,600, against an average of £136,000 for the four following years, in which there was little variation in the quantity of planks, while from 13,000 to 16,000 tons of timber were added to the import each year.—*Timber Trades Journal.*

ENSILAGE.—A correspondent wishes to know all about *Ensilage* for preserving grass, and we hope that some one understanding the process will kindly send an account of it for our next number.

THE ORIGIN OF AMBER.—Some very interesting researches have recently been made regarding the flora of the amber-bearing strata of East Prussia, by Messrs. Gœppert and Menge. In ancient times there must have been in this part of Europe a group of conifers comprising specimens from almost all parts of the world. Among the splendid specimens of the Californian coniferæ were the Red Wood, the Sugar Pine, and the Douglas Spruce; and of the examples of the Eastern States were the Bald Cypress, Red Cedar, Thuja, and the *Pinus rigida;* from the eastern coasts of Asia were the Chillian Incense Cedar, the Parasol Fir, the Abor-vitæ, the *Glyptos strobus*, and the Thuiopsis, the Scotch Fir, the Spruce, and Cypress of Europe, and the Callitris of South Africa. The deposits of amber for which the Baltic is noted are the product of generations of these resin-bearing trees. The richest deposits are situate along a strip of coast between Memel and Dantzic, though the real home of amber has

* Cannot something be done to start a match factory in some of our hill forests? Quantities of deodar timber are wasted every year which might thus be utilized—[ED.]

been supposed to lie in the bed of the Baltic between Bornholm and the mainland. It rests upon cretaceous rocks, and consists chiefly of their *débris*, forming a granular mixture known as flue earth, which appears to exist throughout the province of Samland, at a depth of 80 to 100 feet, and to contain an almost inexhaustible supply of amber.

Immense quantities of amber are washed out to sea from the coast, or brought down by rivulets, and cast up again during storms, or in certain winds. The actual yield by quarrying is 200,000 lbs. to 800,000 lbs. a year, or five times the quantity estimated to be cast up by the waves on the strip of coast above-mentioned.—*Times.*

MR. F. D'A. Vincent, of the Madras Forest Service, who was deputed last year to report on the conservation and administration of the Crown Forests in Ceylon, has now submitted an exhaustive report, giving complete and reliable information on the whole subject. Regarding the area of forests in Ceylon, it appears that 3¾ millions of acres, or about one-fourth of the island, is owned by private individuals, and the greater part of the remainder belongs to the Crown. Of the areas sold, 750,000 acres are estimated to belong to Europeans, 500,000 acres having been bought in the hill country for coffee, tea, cinchona, &c., and 250,000 acres in the low country for the cultivation of tea, Liberian coffee, cocoa, cocoanuts, and cinnamon.—*Pioneer.*

Extract from the Report of the Tributary States of Orissa for 1882-83.

SOME progress has been made in the arrangements for introducing a system of forest conservancy into such parts of the Tributary Mehals as are under direct management. Mr. Davis, Deputy Conservator of Forests, was engaged in examining and marking out the tracts in Angul which are to be formed into forest reserves. The examination has shown that it is worth while to preserve the forests, and the Superintendent considers that the blocks selected are suitable for the purpose. There is some difficulty about determining the boundaries between Angul and the bordering States which will eventually have to be removed. The Superintendent proposes to consider this question in connection with the re-settlement of Angul, as the present settlements come to an end in 1887, and the Lieutenant-Governor will await the separate report which the Superintendent promises to submit on the subject. Mr. Davis had not leisure to visit the Khondmal forests, and these, as well as the forests in Mohurbhunj and Dhenkenal, remain to be examined. It may be possible to depute an officer from the Forest Department to undertake the work during the ensuing cold season.

(We understand that Mr. Moir, Deputy Conservator of Forests, N.-W. Provinces, will be deputed for this work).—[ED]

THE

INDIAN FORESTER.

Vol. IX.] **November, 1883.** **[No. 11.**

NOTE ON THE *DENDROCALAMUS STRICTUS* IN THE CENTRAL PROVINCES.

In the Central Provinces this bamboo is used as a substitute for timber, for rafters and battens, spear and lance shafts, walking sticks, whip handles, ploughman's driving sticks and spade handles, stakes to support sugar-cane; on light soils, stakes for "pán" plants and for construction of "jaffries" for "pán" gardens, for the construction of strong fencings to resist wild animals, the manufacture of small mats used like slates in roofing, mats for floors, covers of carts and various other purposes, sieves, hand punkahs, umbrellas, light chairs and sofas, drenching horns, vessels for holding grease and oil, specially for lubricating cart-wheels; bows, arrows, and cordage, and for the manufacture of many other minor articles. It is also used for the buoyage of heavy timbers in rafting, and when converted into charcoal, is in request for the finer smith's work. Dry stems are also used for torches, and the production of fire by friction.

The fibre in which the stems abound has been found suitable for the manufacture of paper, but owing to the comparatively high value of the product, it is improbable that it will be used for this purpose in the Central Provinces.

The leaves are much sought after as food for buffaloes, and are fairly good fodder for horses.

The seed, which appears to be produced in abundance in times of famine, is at such times used as food grain. Its relative value may be estimated by the fact that while wheat, the principal food grain, sold at 12 seers for the rupee, bamboo seed sold at from 40 to 50 seers.

It is probable that as a living plant, this bamboo will come into use for the consolidation and support of embankments; the complete and endless network of rootlets which develop round every clump, and extend from the surface to 9 or even 12 inches below it, binds the whole surface soil into a solid mass, which

can be cut into blocks with a spade, but is not easily broken until the rootlets either die or decay.*

Distribution.—Widely as this species is distributed, it is not to be found in all localities, nor on all soils. The slopes of hills, ravines, and the banks of nalas are the favourite localities. In the plains it occurs forming dense masses and covering large areas, but on sandy soils only. A rich and free soil, good drainage and plenty of moisture are favorable if not essential to its production; though, as already stated, it is found forming dense masses in the sandy plains; in such places it only flourishes on the banks of nalas or where there is a good deposit of vegetable mould. On a considerable area of poor sandy soil it abounds without attaining any size, and in such cases its existence can only be attributed to conditions being favorable to germination, and to the protection to the young plants afforded by tree vegetation.

In clay soils and the combinations of clay and lime (kankar) not unfrequently met with, the species refuses to grow.

In the black cotton soils of the plains, and even in very wet soils, it will grow luxuriantly when once thoroughly established, but young plants soon succumb to excessive moisture.

Though very productive pure bamboo forests exist in several places in the Central Provinces, the species thrives best when associated with tree vegetation. It is more or less shade-bearing according to age as a young seedling; except under artificial cultivation it will not without shade live through a single hot season, while even with mature clumps, light tree shade appears favorable to the plant, and under the latter condition the yield of individual clumps is greater and finer than in pure bamboo forest.

Pure bamboo forest is altogether unnatural, as may be easily imagined from the foregoing remarks regarding the requirements of the plant. In almost all cases the existence of pure forest of the *D. strictus* is attributable to "dhya" or "bhewa" cultivation (jhuming). The writer has seen innumerable instances of its resulting from this cause. By "dhya" or "bhewa" cultivation every bamboo plant on the ground is set free, and soon outstrips all tree vegetation, thus where the bamboo is abundant and the plants fairly strong, the result is pure bamboo forest, and this condition being established, the restoration of the tree forest is deferred almost indefinitely.

Under the circumstances herein detailed, the absence or greater or less scarcity of the *D. strictus* on sandy plains and hill sides may be accepted as fair evidence of the extent to which the forests have been over-worked, and this supposition is supported by the present condition of the forests in the Provinces, and by what is known regarding their working.

---

* Seed has been supplied to the officers of the Chhattisgarh State Railway for experiment in this matter.

Seeding.—In every forest producing this species, a certain number of stems flower and seed annually, but a general seeding is only an occasional occurrence. Regarding the time or conditions of seeding, nothing definite is at present known, but it is evident that general seedings are associated with a short rainfall.*

In general seedings all clumps of the same age appear to seed within the two years over which the seeding generally seems to extend.

It is the opinion of natives, and one which is believed in by many Forest officers and others, that seeding is prevented or retarded by heavy working of the clumps;† the opinion is doubtless to a certain extent correct, but it is improbable that cutting will have effect if deferred till the clumps begin to flower. It is not an uncommon thing to find small one year old shoots from clumps entirely cut over producing seed.

A solitary clump which seeded in the Maharajbagh in 1877, was cut over as soon as the first crop of seed was gathered, and it is supposed that among the stems cut were some that had not seeded, and from which young shoots subsequently appeared. These young shoots seeded before they were a year old.

That steady working retards seeding may be fairly assumed from the fact that in the forests most worked, the seeding of the species is least common; it has moreover been observed that a poor and unfavorable soil is conducive to the production of seed.

According to our present knowledge, the conditions conducive to the production of seed may thus briefly be stated—

1st, a short rainfall; *2nd*, a poor or unfavorable soil; *3rd*, the condition of pure bamboo forest and absence of the shelter of tree vegetation; *4th*, greater or less rest from cutting.‡

The second condition is closely allied to the first, for the bamboo is a surface feeder, and in forests not protected from fire its impoverishing effect on the soil is very great. It will be observed that all four conditions tend to one end, viz., to check the production of new shoots which must, therefore, be considered

---

* In 1865 there was a general seeding in the hills of "Kalibhit;" in 1868-69 in the belt of forest running from Chônur east of Chanda to the Wards south of Gonpur in the Chanda District, and in 1878 in the Ghotiarpalli forest of Chanda, the uplands of Balaghat and Mandla, the eastern portion of the Satpura reserves, and in the hills south of Jubbulpore, the latter seeding extended into 1879, when it was less abundant. Regarding the rainfall in 1865 in "Kalibhit," nothing can be recorded; in 1868 the rainfall was universally short. As in some cases it is known to have been short, in others it is believed to have been so in the localities in which seeding took place in 1879.

† I do not know any facts in support of this opinion.—D. B.

‡ It would be well worth enquiring whether the age of the clump has nothing to do with the seeding. In the case of the Kattang, [the Kattang *never* seeds except just before dying off, not like *D. strictus*,] which generally seeds gregariously, it seems to be probable that when the plant attains the age of 30 years it is disposed to seed. In the case of *D. strictus* this enquiry would be difficult, as the clumps in a forest tract have sprung up mostly at different times, and are not all of the same age.—D. B.

the primary cause of general seedings. Probably the real cause of seeding is exhaustion of the soil accessible to the roots of the clumps, which is felt the more, the dryer the season; a supposition further supported by the fact that seeding is more common on poor than on rich soils.

Stems that flower casually, yield hardly any fertile seed, and hardly any seed at all, whereas in the general seedings the yield is very large, and of excellent quality, especially in the first year.*

Reproduction.—Reproduction is secured by seed and by rhizomes with rootlets and portions of the stems attached. In the early stage of existence the rhizomes are larger in proportion to the stems, and have greater vital powers. It is also probable that the little shoots resembling seedlings in appearance, which are occasionally produced in dense masses at each node, would take readily if planted, and that shoots laid underground with portions of the leaf-bearing branches above, would take root and produce shoots at each node.

Natural reproduction.—As may be imagined, from what has been said of the seeding of this bamboo, reproduction is to a greater or less extent ever going on wherever the species exist, and the result of a general seeding, notwithstanding that vast quantities of the seed must be destroyed chiefly by rats and birds, and in unprotected forests by fire, is a dense mass of young plants which spring up after the first few showers of rain. In the first stage of their existence the young plants are very delicate, and except under the influence of plenty of moisture, are unable to resist the scorching effect of the uninterrupted sun's rays; they are moreover unable to compete with the minor grasses by which the seedlings are easily and speedily choked and destroyed, nor can they withstand an excess of water about their roots, which causes them to turn yellow, and die off rapidly.

Thus it is that, with rare exceptions, those seedlings only which are more or less under forest cover, live through the first hot weather, or even the first monsoon.

Artificial reproduction.—The artificial cultivation of this species has in the Central Provinces only been carried on since 1875, and, as might be expected, there is much yet to learn on this subject, nevertheless a certain amount of information and experience has been gained which it would be useful to place on record.

In propagating by sets† from existing clumps, it is advisable that three or four shoots with their rhizomes should be taken together with their roots for each pit to be planted, and that as much of the soil as possible should be preserved about the roots. The stems should be cut back immediately above joints to a

* One clump in the "Maharajbagh," the crown of which covered an area of about 40 square yards, yielded 160 seers of seed, besides a quantity naturally shed, which resulted in a dense mass of seedlings round the clump.

† This system, by layers, is practised in Bengal, the bamboo is buried and new shoots are obtained along the joints.—J. M.

length of 5 or 6 feet, the sets should be planted as quickly as possible, 6 to 8 inches of stem being placed below ground. The first burst of the monsoon is the most favourable time for this operation; in the absence of rain the water supply must be kept up artificially till foliage is developed; if the soil is good, further tending will be unnecessary, clumps thus raised on good free soil produce marketable shoots in five years.

In propagating by seed, sowings may be made *in situ*, or seedlings may be raised in nurseries and transplanted. On the former method, experience is confined to the result of one experiment, in which the area dealt with is 50 acres situated on the slopes of hills. The soil was not good, though not extremely poor, but there was a little cover on the ground; the sowings were in prepared lines, but no manure of any kind was applied. The seed was put down in July, but sown too thickly, and at the end of the rains the plants averaged 18 inches, or four times the height of natural seedlings of the same age, but the plants were weak. Had the soil been rich and the sowing less thick, or had the plants been properly thinned on appearance above ground, it is more than probable that the growth would have been really vigorous.

This method of sowing in lines, however, is open to objection, as the lines are attractive as lairs for wild animals, while their continuity assists in directing the enemies of the seed and plants in finding them. It moreover necessitates needless expenditure of seed, as bamboo clumps are not required nearer than 15 feet apart. It is probable that excellent results may be obtained by sowing in pits 3 feet in diameter and 1 foot deep filled with good rich mould, provided the plants are thinned till when 4 feet in height; not more than four plants should stand in each pit.

In sowing *in situ* the soil cannot well be too rich, but if farmyard manure is applied, it must be thoroughly rotten, and the application of wood ashes is preferable. Heating manures must on no account be applied.

To raise seedlings for transplanting, a soil neither exceedingly free nor stiff, neither very poor nor very rich, with perfect drainage, complete exposure to the sun's rays, and if possible, a level surface should be secured. The ground should be well ploughed, and the surface thoroughly well prepared. If the soil is really poor, a little leaf mould and wood ashes may be worked into the surface soil, wood ashes always being applied with advantage.

The quantity of seed required must depend on its quality and the quantity that is likely to be destroyed prior to or during germination. If the seed is good, more than 10 seers to the acre is not likely to be necessary.

The ground may be divided into 4 feet beds prior to sowing, but it will be found most convenient to sow the whole area broadcast, and having harrowed in the seeds with thorns, to divide the area into 4 feet beds, which is necessary to facilitate weeding.

The young plants must not be allowed to crowd each other, but must be gradually thinned, till when 2 feet high they stand about 18 inches apart, at which distance they may be allowed to remain till they attain a height of 3 feet, when they should be ready for final transplanting. Seedlings removed in thinnings need not be thrown away, but may be planted out in lines in nursery beds.

As under the influence of moisture young bamboos will develop new shoots at any season, care must be taken to avoid forcing at least for two months prior to final transplanting, only sufficient water should be allowed to keep the stems and branches alive; the absence of foliage at the time of transplanting is advantageous.

As bamboos need not as a rule be planted nearer than 15′ × 15′, an acre of nursery will suffice for planting about 80 acres.

If it be possible for the first month after transplanting to keep up the water supply artificially during short breaks, planting should be carried out on the fall of the first monsoon showers, as in this way the aftergrowth is greatly accelerated; otherwise planting should be carried out with as much despatch as possible, as soon as 15 or 20 days' rain can be calculated on.

In moving the plants, care must be taken not to disturb the roots, and to preserve as much soil as possible about them; when placed in the ground, the new soil must be closely pressed down round the plants, and sufficient water must be supplied to thoroughly saturate the whole of the soil in the pits; in well drained localities the supply of water can scarcely be too copious.

If the plants are in new leaf when put out, every precaution must be adopted to prevent the shed of foliage, the loss of which at this time is at least equivalent to the loss of a whole season's growth, and will only too often result in heavy losses in plants and sometimes in total failure.

On the other hand if the foliage is preserved, or in the case of plants which have not come into new leaf, their stems and branchlets are kept alive until the regular rains set in, a most vigorous growth will be secured.

Aftergrowth.—The plants even when established have many enemies, the young rhizomes are readily eaten by rats, pigs, and bears, and the young succulent shoots as they appear above ground are nipped off and eaten by bison, pig, and sambhar. In the natural forest these enemies as a rule make but a slight impression, but in artificial plantations and nurseries, rats, pig and even bears, attracted apparently by the regularity of distributions, and by the conspicuously prepared soil commit desperate havoc. The measures that should be resorted to for protection against these enemies must depend on local conditions and the means available, but it may be noted that keeping the soil well worked, and free from grass and weeds, and copious watering, each and all afford protection against rats.

A plant once established, if undisturbed goes on increasing the number of its shoots until the time of its flowering, notwithstanding that some die and decay; and the size of the shoots continues steadily to increase till what may be considered full size shoots for the particular soil and locality are produced. The number of years necessary for the production of full sized shoots is undetermined, but is known to vary greatly according to the conditions under which the plants have grown up. In natural forests there is reason to believe that full sized shoots are not produced until the clumps are about 12 years old, but in really successful artificial plantations the time will probably be reduced to six years.

Thinning of the clumps does not stop the production of shoots, and if judiciously executed appears to favour it. Complete cutting over of the clumps even when of large size, throws back the after-growth, resulting in the first instance in the production of small shoots from the joints of the rhizome 3 to 6 feet in length; and the gradual process of the shoots increasing in size year by year till the full size is obtained, has then again to be gone through. The effect of such cutting over is, however, less in proportion as the number of stem joints left is greater.*

Each rhizome is provided with one or more eyes, from which new shoots and rhizomes are produced. In young plants and clumps, new shoots are produced from the last formed rhizomes, which accounts to some extent for the annual progression in the size of the stems. This system of production by progression from the last formed rhizomes does not, however, long continue, and ceases altogether, after shoots of full size have been produced; after this stage has been attained, new shoots appear most commonly to start from two year old rhizomes.

Whether shoots are ever produced from rhizomes that have been completely deprived of all portions of their stems has not been finally determined, but to the entire loss of stems is at present attributed the death of many clumps cut back on boundary lines.

The production of new shoots by young clumps is confined to no fixed season of the year, but goes on rapidly under the influence of moisture. This condition gradually changes as the plants grow older, till when full sized shoots are produced, production is confined to a fixed period, usually between the 20th August and the 20th September.

Seeing how closely allied the existence of foliage is to the production of shoots, it is easy to understand that eyes nearest the crowns of the rhizomes should as a rule be the first to start, and

* In Púnasa, bamboos of this species, which formerly were cut completely over every year, continued to produce shoots, small it is true, but not below the average size of those removed. Here, however, the cutting was never flush with the ground, but about 4 feet above it, and all old stumps with their branches were left.[1]

[1] Consequently plenty of leaves were left to keep up the vigour of the plants.—D. B.

that those on rhizomes having good leaf-bearing stems should be the most likely to be productive. It also accounts for new shoots not being produced from one year old rhizomes, the shoots on which are slow to develop foliage. The position of the eyes, the size of the rhizome, and the amount of foliage with which they are connected, also help to account for variation in the size of the shoots produced. If all these conditions are favorable, abnormally large shoots will probably result, if adverse, the reverse may be expected.

Except when artificially watered, the younger the clumps, the later they are in coming into leaf, and the younger* the plants the less the effect of the absence of foliage in retarding the development of new shoots.

Yield.—Owing to the want of a proper system of working, the possible yield of bamboo forest is as yet undetermined In some cases production has been diminished by the denseness of the crop and the impossibility of all shoots that start forcing their way through the mass of stems that stand above them, in other cases by the removal of stems that should have been left standing, while many shoots have undoubtedly been destroyed by animals, &c., as soon as they appeared above ground.

It may, however, be said that 150 large clumps per acre form dense bamboo forest, and that when there is a full crop of bamboo on the ground, the yield per acre does not ordinarily exceed 300 stems. That this yield can be vastly increased is a point beyond dispute. How to secure increased production will be discussed further on.

Treatment.—In the treatment of this species there are three objects to be kept in view—

1st. To secure the largest possible sustained yield.

2nd. To defer or if possible prevent gregarious seeding.

3rd. To secure the reproduction of the species in case of a general seeding.

Association of tree vegetation.—It has already been indicated that *D. strictus* thrives best when associated with trees, and that under other conditions the establishment of a new crop after a general seeding is not likely to result. It is therefore evident that the preservation of a certain amount of tree vegetation is desirable and probably necessary. The trees preserved should, however, be of the lofty varieties, which will not interfere with the spread of the crowns of the bamboo clumps. As really useful and moderately plentiful trees—saj, bíja-sál, and rohun (*soymida febrifuga*)—may be mentioned as desirable, anjun does not

* In 1878 a large stock of one year old plants were removed from a nursery bed at Taluckherri, and to all appearances the ground was completely cleared of plants. In this nursery, however, a fresh stock has come up, and in the space of two years, equalling in height the largest of the clumps resulting from transplanting, notwithstanding that the latter stand on equally good soil.

appear to affect the localities best suited to the *D. strictus*, and teak can only hold a place on its own intrinsic value and the suitability of the soil; but bhiri,* mokha,† and a few others may in some places be desirable. Mokha can only be tolerated on deep sandy soils, under other conditions it is too much of a surface feeder. The number of trees it is desirable to preserve must depend on a variety of conditions, but the writer would recommend that the leaf canopy resulting from tree vegetation should not exceed one-half and not be less than one-and-a-quarter of the total area, *i.e.*, assuming the production of bamboo to be the primary object. The lighter the foliage the more trees may be returned to the acre. This course will tend in a great or less degree to each and all of the ends to be kept in view.

Preservation of fertility in the soil.—Seeing that this species loves a rich soil, and that being a surface grower, the soil accessible to its roots is extremely limited, the necessity for protection to prevent the leaf annually shed being destroyed and washed away is above all things necessary.

Thinning of clumps. As regards cutting or thinning, it is obviously essential to preserve in a vigorous condition those eyes whose turn it is next to produce shoots; it has already been indicated that after clumps have produced full sized shoots, reproduction is generally from rhizomes of two years old, though occasionally it proceeds from those of greater age. It is, therefore, obvious that to secure a maximum production no shoot should be cut until the end of the second monsoon succeeding that in which it was itself produced,‡ unless increased production is rendering the forest too dense, a condition which cannot be said to exist as long as there is ample space for the full development of foliage on all standing stems, and clear space for the upward course of new shoots. That the removal of all other stems will render more certain the production of shoots from the rhizomes of older stems left, may fairly be assumed from the fact that it will diminish the drain on the food supply available for the nourishment of new shoots, and that it will leave more space for the development of foliage on the standing stems. Thus with the exceptions above noted, the preservation of all stems till the end of the second rains succeeding their development is calculated at least to maintain the production of shoots.

Thinning a prevention of seeding.—The maintained production of shoots must prevent general seedings which only succeed the cessation of the production of shoots. It is also probable that the complete removal of the older shoots will result in the decay of

* Satin wood (?) † *Schrebera swietenioides* (?)

‡ Quite right; but it would be a regular Chinese puzzle sometimes to get at the three year old and upwards without cutting down the younger ones. We should require some one's patent "bamboo cutter." This may, however, be partially secured by rotation, the bamboo forest being divided into blocks, each of which is closed in turn for two years.

the rhizomes attached to them, and that thus the stems left will become independent of the old parent-root, and be less likely to seed than if their connection were maintained.

Mature stems that may be removed.—As long therefore as the production of shoots does not annually increase, and there is no indication of the standing crop being too dense, all shoots should be preserved till the dry season following the second rains after that in which they were produced when they should be cut and removed.

Cutting of young stems when necessary.—When to meet special demands for what are known in the market as green bamboos, it becomes necessary to cut younger stems, the cutting should not be flush with the ground, but 2 feet above, thus leaving eyes for the development of branches and foliage to preserve the vigour of the root, and the cutting should be confined to a small proportion of the young shoots in each clump. Where, however, the crop is tolerably full, and the annual production of shoots is on the increase, a limited number of young shoots may be cut down to the ground without fear.

Cutting of young stems when possible without reducing production.—When the crop is full many young shoots may be cut annually; the test must be the rate of production. If for instance 600 shoots per acre are produced in 1880 and preserved, and in 1882 the number produced is 900, while 1884 gives no further increase, it will be obvious that about 300 young shoots may be removed annually without decreasing production.

Season for cutting.—With the view to production, the best season for cutting is from the time the leaf begins to fade, up to the time the clumps become leafless.

Method of working.—When the conditions herein indicated can be secured, the working of the whole area and every clump annually will be advantageous, but where this cannot be done, the working of the forests in blocks on a three years' rotation will probably secure the closest approximation to what is desired.

General remarks.—The value of cut bamboos varies according as they are green (young) or dry (mature), and again in the latter case on the time of cutting and the method of seasoning. In the vicinity of large towns and markets the higher value generally attaches to green bamboos, being sometimes as much as twice that of dry bamboos. As regards seasoning, the preference is in some places given to bamboos that have been soaked in water for a lengthened time, while in others bamboos thus seasoned will not command a market. The chief use of water seasoning appears to be the destruction of the insects which attack the bamboo when cut out of season. The belief in the effect of the moon* on the durability of the bamboo is universal with all natives of these Provinces. The theory is that bamboos cut when there are

* And the removal of the fermentescible reserve material stored in the shoots—[ED.]

bright moonlight nights are invariably attacked by insects, and that those cut when the nights are dark are not thus attacked. Several instances have been observed which support this theory, but whether it be attributable to the activity or otherwise of animal or vegetable life under the two different conditions is uncertain. Observation, however, leads to the conclusion that cut bamboos are less liable to be attacked by insects while in the forests than after being brought into the open or placed in buildings. Bamboos cut in the rains are always liable to speedy decay.

To prepare and dress bamboos for such special purposes as spear shafts, they are first soaked in water, then passed while wet through a slow fire made up of damp grass, &c., and while heated all crooks are as far as possible bent out, they are then oiled and suspended from one end with a heavy weight at the other until they set perfectly straight.

Owing to the tendency of the product to decay, the trade in bamboos is a somewhat precarious one, requiring an intimate knowledge of the market to enable the trader properly to regulate the supply by the demand.

If kept perfectly dry, bamboo seed will remain good for two years and perhaps for a longer period, but the writer would not recommend its being relied on after being more than two years on stock.

Were the existing supply of bamboo evenly distributed throughout the Government forests of the Provinces, the result would be a vast increase in the demand, but at present in a large portion of these forests there is an absolute dearth, if not absence, of this product, which in such *cases commands an excessive price,* while in others, notwithstanding that consumption is vastly in excess of actual local requirements, the demand only amounts to an excessively small portion of the possible outturn.

J. C. D.

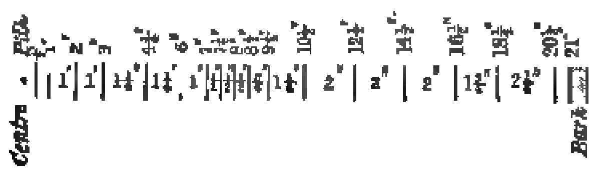
RAPID GROWTH OF TREES IN ASSAM.

TO THE EDITOR OF THE "INDIAN FORESTER."

SIR,—In your number for July, on pages 358-9, I drew attention to the remarkably rapid growth and renewal of forest in some parts of Assam, and I have now the opportunity to confirm those remarks, at least in one case, in a way that will show the rapidity of the growth of at least some trees in Assam.

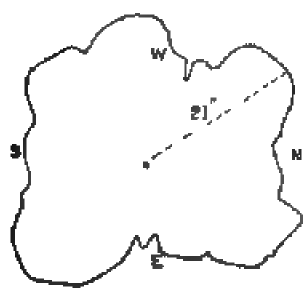
Last August needing some simal (*Bombax*) wood for tea chests, the men felled a tree that grew on the site of the old coolie lines. The elephant dragged in five logs of about 10 feet each, all from one tree. They were all fairly large logs, and the lower ones measured over 2 feet thick, and in one place the base of lowest log was 44 inches across. As I had formerly known the site, and did not remember any large trees there, I asked the Mohurir how old the tree might be, and he surprised me by

saying it could not be much over 16 *years*. This I did not quite believe. I lately saw the stump, and as it was cleanly cut, I could see the rings, and the size of them so astonished me, that I counted them along two radii, and in each the number came out 16. I shall, if possible, cut out a block to forward for the Forest School Museum, Dehra Dún, and you will see at once very clearly that the growth annually is as much as 2 inches between the rings at times, and in no case under half an inch.



The above is the series of annual rings along one of the radii *to scale* (felled August 1883).

I have never before seen an annual increase of the growth radially as rapid as this. The plan of the stump is shown in diagram. The measured radius is per dotted line. About 150 cubic feet of wood was in the logs, and the mistri in charge of the saw-mill tells me that the half inch planking that came out was fully 2,000 feet superficial.



I am sorry I did not at the time register it, as I could easily have done, and shall do so in future in all noteworthy cases.

The decrease and increase in the annular growth is so marked and so steady, that it would be interesting to know if the minimum, which occurred in 1874-5, was at a period of sunspot minima, or not.

Naharani, Assam, 8*th October*, 1883.

S. E. Peal.

NOTES ON "INDIRECT INFLUENCES OF FORESTS ON RAINFALL IN MADRAS.* BY MR. BRANDIS."

UNDER instructions from the Government of India (Revenue and Agriculture, No. 41—16-1 of the 8th May last), I have the honour to communicate, for the information of H. E. the Gover-

* Copy of a letter from H. F. Blanford, Esq., Meteorological Reporter to the Government of India, to the Secretary to the Government of Madras, No. 1191, dated the 9th June, 1883.

nor in Council, the following remarks on the measures to be taken to give effect to the recommendations of Mr. D. Brandis, late Inspector General of Forests with the Government of India, as expressed in para. 209 of his suggestion regarding Forest Administration in the Madras Presidency.

The object of Mr. Brandis' suggestion in this part of his report is to obtain registers of rainfall from places far from habitations, and where, therefore, it is practicable to take the readings of a rain gauge only at monthly intervals more or less. It is one to the attainment of which there is but little previous experience to guide us, and any measures that may be proposed must be in a large degree tentative. I should, therefore, not recommend that any extensive preparations be made to carry out Mr. Brandis' proposals until a form of apparatus shall have been discovered which, after ample trial under sufficiently varied conditions of site and exposure, shall have been found to give good and trustworthy results.

In addition to those conditions of construction and exposure which are essential to all rain gauges, it must fulfil the following: —

(a). It must be protected against choking by dead leaves or other matter collecting in the recipient.

(b). It must be protected, as far as possible, against injury by wild animals or stray cattle. Against wilful injury prompted by malice or idle mischief hardly any precautions can be effective.

(c). It must either measure and register the rain as it falls, or it must store the rain water till this can be removed and measured, evaporation being meanwhile kept down to a minimum, and if there be any loss by evaporation, it must afford the means of checking it.

(d). If the plan of storage be adopted, the area of the receiving surface and the capacity of the receiver must be so adjusted that the latter must be more than sufficient to contain the maximum fall to be anticipated in the interval between the measurements.

Of the above conditions the first (a) is that which presents the greatest difficulties, more especially in forest tracts, and indeed I doubt whether any precautions that may be taken will prove at all times efficacious. It must, therefore, be a standing instruction to the person who measures the rainfall, always to examine the aperture of the receiving funnel, and if it be found choked, to note the fact against the measurement. In general, such measurements would have to be rejected.

Partial protection may, however, be secured by selecting a place for the gauge as far as possible from trees and bushes. Any growth of the latter should be kept cleared for a radius of 20 or 30 yards around the gauge, and the gauge should be buried to

within one foot of the mouth on the summit of a conical mound of earth, or earth and stones, not less than 4 feet in height. The aperture of the funnel by which the rain water enters the receiver should be not less than ¼ inch diameter, and it should be a simple hole without any tube. It will be better to run the risk of a little extra evaporation than that of choking by the accumulation of dust. Against choking by dead leaves some protection may be afforded by a conical wire-cage, made of a conical spiral of wire with radial wires soldered on; the base of the cone to rest on the sides of the receiving funnel about half way down.

Protection against wild animals (*b*) may be best afforded by a strong close fence which may be made of rough logs not less than 6 feet high, and at a distance of not less than 8 feet from the gauge in all directions. Where wild elephants abound a second fence outside might be found necessary. This would be a question for the local officer to decide. Against monkeys no fence would prove sufficient, since their acts almost fall within the category of wilful mischief. Perhaps, however, the addition of some bundles of thorns to the fence might prove a deterrent.

Although I have suggested (*c*), the alternative of some form of self-registering gauge, I should not be prepared to recommend its adoption. All such gauges are more or less easily put out of order, and in wild places there would be much difficulty and delay in rectifying even slight injuries. The other alternative is the adoption of a gauge with a large reservoir and accompanied with an evapometer, so constructed that the evaporation from both is the same, while the evapometer is protected against the entrance of rain.

A gauge on this principle was proposed some years since by Mr. Hutchins, Deputy Conservator of Forests, Mysore, and a slightly modified form of this gauge was in use for a year at the Alipore Observatory, and a monthly measurement of the rainfall collected in it was compared with the sum of the daily readings of a gauge of the ordinary pattern. The results of this comparison are published in the Journal of the Asiatic Society of Bengal, 1881, Vol. 50, Part II., page 83. The monthly measurements showed a constant excess varying from ¼ to $\frac{3}{10}$ of an inch of rainfall. This error was traced to the too great evaporation from the evapometer, and this in my opinion was due to the fact that the latter vessel was only one-fourth the depth of the receiver of the rain gauge. Were the depth of the evapometer trebled (made equal three-fourths the depth of the gauge-receiver), I have little doubt the results would have been much better.

The modified gauge is calculated to receive and store 24 inches of rainfall. In most parts of the Madras Presidency this capacity would be ample to provide for a month's storage, but on the Western Ghâts and in Canara such a gauge would have to be visited and emptied weekly during the rainy season, and might even then prove insufficient. If however, the funnel, instead of being of 8 inches

internal diameter, be reduced to 5 inches, the dimensions of other parts and that of the evapometer remaining as before, it would suffice to store 60 inches of rainfall, and this would be much better than increasing the size of the receiver.

The best material for the construction of the rain gauge and evapometer is stout sheet zinc, the lip of the funnel being a stout levelled ring of brass accurately gauged to 8 inches (or 5 inches) internal diameter.

The measurement of the rainfall (and of the residual water in the evapometer) would require some precautions, and it should not be left to an uneducated subordinate, nor even to an ordinary native clerk. It would almost of necessity have to be recorded on the spot, for, even if the water were carried away in suitable closed vessels to be measured elsewhere, the visiting officer would have to regulate the water left both in the gauge and the evapometer, and this would require the same care as the subsequent measurement of the contents.

The water in both vessels should be measured roughly by a graduated dip-rod before being poured into the measure glass for more accurate measurement. In this way a rough measurement will have been secured even should any portion be accidentally spilled in pouring. To facilitate pouring, the receiver should be provided with a short spout or lip. The dip-rod would be differently graduated for the same receiver used with a 5-inch and an 8-inch funnel. In the latter case (the receiver being 8 inches internal diameter) the graduation would be in true inches and tenths; in the former case each inch of rainfall would be represented by 0·41 inch on the rod, or the same rod being used, its reading would be multiplied by the factor 2·44 to give the depth of the rainfall registered with a 5-inch funnel. The measure-glasses used for 5 and 8 inch gauges respectively of the ordinary dimensions would, of course, answer for these gauges.

Every gauge before being brought into use should be verified at the Madras Observatory for the accuracy of its dimensions. For the general description of the mode of using the gauge, I append an extract from the paper in the Journal of the Asiatic Society of Bengal.

Finally, with reference to the remarks in para. 2 above, I would recommend that any officer who may be entrusted with the practical execution of the measures proposed, be instructed to place himself in communication with this office for obtaining any further information that he may require.

Extract from a paper on the "Description of a Rain-gauge with Evapometer for remote and secluded stations," by H. F. Blanford, Esq.

"The instrument proposed by Mr. Hutchins consisted of two cylindrical vessels of equal size, viz., 8 inches diameter, one,

three times as deep as the other,* which were to be buried side by side in the ground. The deeper, which was to receive the rain, was surmounted by a funnel of the usual character, also 8 inches in diameter, having a small hole at the bottom through which the rain should run into the receiver. The other, which was to serve as an evapometer, was closed by a conical cover with a small hole at the apex, and over this was supported a second conical cover of the same diameter, leaving an interspace of about ·1 inch through which the vapour might diffuse and escape around the edges. Both were to be padlocked, to prevent any vitiation of the results, by unlicensed interference on the part of any too curious inquirer.

"Before having the instrument constructed, I slightly altered the design by reducing the size of the outer or protecting conical cover of the evapometer, and surrounding both the receiving cylinders with a second outer cylinder, in order to protect the upper part of the receiver more effectually against direct heating by the sun. The instrument, thus modified, is represented in the accompanying figure; it was made at the Mathematical Instrument Department, and in March 1880 was set up at the Alipore Observatory, buried in the ground, in the immediate neighbourhood of the 5-inch Symon's gauge, which serves for the daily measurement of the rainfall.

"At the beginning, 4 inches of water, measured in the measure glass, for the 8-inch gauge, was placed in the evapometer, and an equal quantity in the receiver of the gauge (in order to provide for evaporation in anticipation of rain). At the end of a month, the water in both cylinders was measured, and the difference taken as representing the rainfall of the period. Four inches of water was then replaced in each cylinder, and the instruments were closed and left untouched for another month."

NOTE ON FIRE-PROTECTION AS CARRIED OUT IN THE CENTRAL PROVINCES.

In circulating the following note on Fire-protection amongst Forest Officers in the Madras Presidency, S. D., Major Campbell-Walker remarks as follows:—

Forest Officers will bear in mind that the object of exterior fire lines is to secure *complete isolation* and protection from without, and of interior fire lines to localize fires which may enter or occur within the forest under protection.

Once thoroughly isolated, everything depends upon the vigilance of the protective establishments, whose duty it is to prevent fires being kindled except in places specially set apart for the purpose, to enforce the prescribed precautions, and to extinguish fires which may take place from any cause.

It will be observed that the fire watchers must be on their lines *night and day* during the fire season, huts being built for them, and their being constantly on the alert secured by constant inspection. Mr. Hooper gives two miles of fire line to each watcher, but for the present one mile will be ample to entrust to one watcher in this Presidency, so that there should be a hut for every two miles of fire line in which two men will reside. In the Central Provinces the watchers are supervised by Forest Guards, but until our Guards have more experience, it will probably be advisable to place a Forester in charge of each block of any size, aided, if necessary, by one Forest Guard for every five or six watchers.

Mr. Hooper states that the dangerous season is from the 15th March to 15th May, but much naturally depends on the district and duration of the rains. In the West Coast Districts not subject to the North-east monsoon, and even in the Eastern and Central Districts, if the North-east rains are scanty, the grass is dry and inflammable as early as January, and the fire lines should be cleared, and arrangements made for the entertainment of watchers, by December.

The width of the fire lines must depend upon local circumstances, of course the narrower they can be made with safety the better, as they represent so much unproductive or nearly unproductive space. On the other hand, it is better to sacrifice a part than the whole, so we must not hesitate to sacrifice boldly in order to secure complete protection and immunity from fire. In first attempts especially, success must be ensured at any cost.

It is not, as a rule, necessary to *cut* the grass or undergrowth over the whole breadth of fire lines. If a path from 3 to 10 feet wide be cut *on either side, and the cut grass piled up inside and set fire to under* favorable circumstances, it will generally suffice to ignite and burn off the whole if sufficiently dry. When necessary cross paths, styled "ladders," may be cut at right angles to the fire line and the grass burnt off in patches.

Burning is best done at night or in the early morning, and whenever there is little wind. While burning a sharp look out must be kept against "head fire," *i.e.*, burning leaves, &c., carried over the belt. Each man engaged in the burning should carry a broom of green branches of some soft leaved tree to beat out fire crossing the paths.

Trees of any size and value may be left standing, but their leaves must be swept up and destroyed daily, and the fire lines kept perfectly clear of all inflammable substances until the rains have well set in, and there is no further danger, when the staff of watchers may be reduced and gradually dispensed with.

In placing a block of forest under fire protection, advantage should be taken of all natural features which, with the configuration of the country, prevailing winds, direction from which danger is most to be apprehended, &c., must be carefully studied by the Divisional Forest Officer.

A line of cliffs or a belt of evergreen forest is an excellent natural fire line requiring little or no clearing.

As stated by Mr. Hooper, rivers, unless sufficiently broad and perennial, are not good fire lines.

The outer line should, as a rule, correspond with the outer boundary of the forest, and the inner lines as much as possible with forest roads, inspection paths, and compartment division lines.

It is preferable to follow the top of a ridge to the bottom or half way down the slope, and where there are spurs running out from a centre hill or ridge, the fire lines should run along the top of them rather than across them on contour lines.

Officers will be careful not to attempt too much in the shape of fire-protection at first, the entire protection of a comparatively small area *for a number of years being better than partial protection of a much* larger area.

The most accessible and easily protected areas should be first attempted so as to ensure a reasonable prospect of success.

The procedure recommended by Mr. Hooper with regard to supervision, reports, and keeping accounts will be adopted, and translations of his Note and this Circular in the vernacular supplied to all the subordinates not conversant with English employed on fire-protection.

As soon as the grass becomes yellow in October, operations commence by cutting the grass on the fire lines and spreading it evenly on the ground cut over;* according as November and December are dry or wet so is the burning operation hastened or delayed, but the object is to get the lines quite clear by the 1st February. In the Central Provinces, except in occasional seasons, and then only in the Southern Districts, we get no North-east monsoon rains, and after the end of September the only rain until the following June falls at Christmas and in April or May.

The fire season in the low country does not set in until the month of March, when the dews cease. On the Satpuras and along the Ghâts to Bombay, the hills burn earlier, and in Nimár line burning is commenced in November, and requires to be very carefully done. In the Sandúr forests, Bellary District, this year the hills did not burn until the 15th March. Fires had occurred off and on during three months previously in the scrub jungle on the rocky plains below, but did not spread far nor burn fiercely. Probably the 15th of February is about the date for employing the full staff of watchers in the Sandúr forests, and by that time the lines should be cleared.

It should be remembered that Protection to be complete, should provide for the prevention of fires coming from outside and also against their occurring inside the blocks. In the Central Provinces of late years few fires have crossed our lines, which are more thoroughly cleared year by year. The fires that have done damage have been lighted by persons travelling in the forests, and occasionally lightning may have been the cause. In no known instance has the friction of dry bamboos caused fire, though the native population ascribe to this all fires the origin of which cannot be traced. It is impossible to make *sure* of protecting any forest, but we can reduce to a minimum the possibility of fire by having thoroughly isolating fire lines, good patrolling and interior roads cleared, burnt and watched, while the damage by fires that do occur can be minimised by making a number of small blocks instead of one large one, utilizing for this purpose the interior cleared roads. In the Rámandrug Range, Sandúr forests, of 15,000 acres, I had this

---

* We much prefer throwing the cut grass along the edge of the standing grass to be burnt, a plan which facilitates very considerably the work of actually burning over the line. But in some cases when the growth of grass is not very heavy, no grass need be cut at all, the very first operation being the actual firing of the standing grass.

year six separate blocks. A fire crossed the main fire line on the 23rd March, and burnt with such fury that nothing in the way of beating out could stop it, yet it burnt itself out on a block line taken down off the spurs and along the ridge. I think 2,000 acres is about the best size for a fire block.

One of the most important operations is the selection of the fire lines. I consider that it is highly desirable for the sake of economy to take the forest boundary as the main fire line; by so doing the clearing of the fire line tends to make the demarcation permanent and prevents encroachment, the fire patrols by their presence check theft, and the work of inspection and export of produce is facilitated by these completely and annually cleared fire boundaries. In the case of some reserves the peculiar features of the country and the awkward position of surrounding private properties have necessitated a sinuous boundary, rocky or precipitous, crossing a series of deep bedded torrents. Such a boundary, though offering facilities for establishing prominent land-marks, forms a most inconvenient and expensive fire line, for the growth of grass and scrub is uneven; the difficulty of patrolling prevents watchers from doing their work honestly, and the length to be cleared is great compared with the area enclosed. Under such circumstances if the adjoining property is available, the fire line might, by arrangement, be taken through it on the understanding, if private property, that only the grass land be burnt within certain limits. The best fire lines are long stretches of grass-land, the tree vegetation on which sheds its leaves early in the season. Such lines may generally be found along the spurs of hills or along their tops when covered with laterite, with *Boswellia*, *Sterculia*, *Schleichera* and *Cochlospermum* sparsely distributed over them. River courses, unless of themselves sufficient to completely check fire at the driest season, should not be used as fire lines.* Their banks remaining green until well on in the season, prevent their being burnt except by a strong sweeping fire burning across them, and the work of clearing them by cutting in the early part of the season cannot be satisfactorily performed owing to the irregularities of the banks and the dense mass of ever falling foliage which lines them.

The work of clearing should be commenced by cutting away the trees, bamboos, and grass to the width required, leaving only the more valuable species which are either evergreen, shed their foliage early, or have large leaves.† The initial charge for this felling makes the cost of the first year's protection abnormally

* Our own experience, extending over 9 years in various parts of India, does not bear out Mr. Hooper's fears on this head.

† This clearing of a certain portion of the forest growth seems to us to be quite unnecessary. Something might be said in its favour if the obnoxious vegetation could be killed off once for all—a very difficult and expensive operation to accomplish.

high, but if there is any demand for such produce the revenue derived from its sale justifies the debiting of a portion of the line clearing cost to the head of charge corresponding to the revenue head concerned. Bamboos require to be got rid of entirely; their presence even *near* the line is to be discouraged, as they constantly foul the cleared line by their falling leaves. I make it a rule to save teak, *Terminalias*, *Schleichera*, *Melia indica*, *Dalbergia latifolia* and *Pterocarpus marsupium*, when they are already big poles.

The width of the fire line is not a matter which can be determined by rule; under some circumstances a 10-foot line is sufficient for ordinary fires, in others a 100-foot line is insufficient.* In the Central Provinces our fire blocks are, many of them, situated in the midst of Government waste, and these wastes we burn over when our fire lines are clear and the fire season well on. *This is also done to certain private lands when* we obtain the permission of the proprietor. Once the surrounding country is burnt, which generally happens by the 15th May, the danger is much reduced and we commence to reduce the strength of the fire patrolling establishment. My own opinion is that with the local facilities we possess in the Central Provinces our fire lines of from 40 to 70 feet represent a loss of production which is not necessary on the score of safety, and that we might discreetly, with our present knowledge of what is requisite, commence to allow a growth of forest over from 10 to 20 feet in the innerside of our fire line; we would still have a cleared line of 25 feet and the power to burn the surrounding lands.†

In cases where the fire line runs through valueless jungle and grass, and where the outside land may not be burnt, I would advocate a 30-foot line, increasing it to 50 feet wherever the line runs along a hill side covered with high grass. On the other hand, when clearing through hill forest and on rich forest soil which, by the nature of it, admits of little grass except on the lines we annually clear and burn, a width of 20 feet is ample, especially if the outside forest soil be cleared of inflammable matter for a few extra feet in width.‡

The cost of cutting the grass on a 30-foot line,§ when grass-cutters' wages are three annas a day, will amount to Rs. 7-8 per running mile, and probably more the first year, but it all depends upon the supervision. After one or two years it will be found possible to give it out to villages on contract. The coolies will come in gangs under their own headmen and arrange the terms

---

* We should say even a 300-foot line.

† This bears out what we have said in a previous foot-note.

‡ We confess we cannot quite follow Mr. Hooper here.

§ Does Mr. Hooper advocate the grass on the entire width of the fire-line to be cut? Surely a very unnecessary expenditure of labour and money.

with the subordinate officers in the month of August, when for a little advance they will accept a fairly low rate.

In cutting the grass, care should be taken to spread it evenly over the line,* leaving a clean strip of a few feet on either side to prevent the fire spreading to the forest. I do not consider it necessary to grub up the grass roots along this side-path, for the expenditure is considerable, and the good, if any, only temporary, the grass springing up again gradually year by year. It is expedient to have a fairly good bridle-path along the line, but for such a purpose I would advocate no special expenditure being incurred, leaving the work to be performed by the watchers, who, once their line is in good order, have little or no work to do. The progress they make in the clearing of a bridle-path is a sure register of their presence at their posts. All they have to do is the clearing off of stones and the smoothening of rough places with an occasional water-course to make a path down to and from.

Once the grass is spread it should be left until quite dry; much cost is often incurred by partial burnings leaving a dirty line which, safe enough for a month or two, will always remain a source of misgiving as to its safety, and to clean which will probably cost an extra Rs. 5 to Rs. 6 per mile. This will be the most troublesome part of the first year of fire protection. It is due to the ignorance of the coolies and establishment supervising, and their fear of creating an unmanageable fire. By employing the same people a second year they will be found to gain confidence in themselves, and can safely be trusted to know when to burn the spread grass. It is advisable to instruct them to burn the line very carefully in an oblique direction, the fire being lighted nearest to the reserve and burning away from it. The cost of this work will not then exceed Re. 1 per mile,† but it should always be done under the supervision of a Forest Guard.

The same remarks apply to the work of clearing block lines. As for roads, the amount of protection by clearing and burning which they require will be found to depend upon the nature of the traffic over them. When such traffic is completely local, and the road a high road, there is little danger; but when there is any through traffic, or the road a country track, the risk of fire is great and special measures of precaution necessary. In the Sandúr hills I have this year burnt for from 20 to 30 feet wide all the grass on each side of the Military high road, and such protection will be necessary for several years until the forest has grown up and the grass is dead. Foot-paths, where frequented by surrounded villagers, should also be cleared and burnt for about 10 feet, or else their use permitted conditionally on the surrounding forest being preserved.

* See a previous foot-note on this subject.

† This rate is surely far too low for a great many forests.

The patrolling of the lines should commence by the 15th February and continue until the monsoon is well set in. The best patrols are aboriginal tribesmen, who alone, as a rule, will accept such service, which necessitates their living day and night on the line with the chance of constantly meeting with wild animals. The more inaccessible a fire line and the more remote from habitations, the greater the difficulty of getting patrols, and the less likelihood of such men's work being supervised. I have been accustomed to give two miles of line to each man to look after, arranging that two men live together, building a hut for them to live in near water, and, if possible, on the line itself. They are only allowed to absent themselves on substitute, and dismissal follows on absence from duty without leave. Their orders are—

1st.—To patrol their line.

2nd.—To carry on messages from watchman to watchman.

3rd.—To keep their line clear of vegetation, fallen leaves, &c.

4th.—To brush all such material into heaps to be burnt by the supervising Forest Guard.

5th.—To report occurrence of fire and to assist in extinguishing it, this being the sole reason for their leaving the line without special order.

6th.—To warn all travellers against firing the forest and to prevent their carrying fire openly.

7th.—To be responsible for the safety of their line.

These fire patrols may be dismissed by the officer in charge of the Reserve if the patrol is a new man, but the case has to be reported to the Range Officer. If the patrol has already served one season, I retain the power of dismissal in my own hands.

In the Central Provinces we pay Rs. 4-8 a month to watchers as fire patrols.* In Bellary this year the only men procurable were Brinjaries on Rs. 5 per mensem.

Over the fire patrols I place Guards, either permanent or temporary, on not less salary than Rs. 6 a month. They live either on the line in huts on the high roads, or else in the nearest villages. In the Central Provinces they are on the line,† but in Bellary we have not as yet got men to live there.

As Guards I do not employ the country people if other outsiders are available; their duties are—

1st.—To patrol the line, having probably four watchers under them.

2nd.—To superintend the watchers' work, and burn the rubbish heaped up on the line by the watchers.

3rd.—On the outbreak of fire to order a watcher off to report it to his superior officer, himself to go and put it out, or, if necessary, secure assistance.

---

* This is not quite correct. As much as Rs. 6 and as little as Rs. 2-8 have been paid in certain districts.

† Not so in every district.

The Guards should not leave the line without permission. The temporary Forest Guards so employed are drafted into permanent service if they do good work.

Over them is the officer in charge of the Reserve, either Forester or Ranger; if the Reserve be large, there may be several Foresters. *Their work is to be responsible to the Divisional Officer* for the safety of the forest, to submit weekly diaries showing the progress of line clearing and his subsequent inspections of the line. On a report of fire reaching him he should proceed to put it out and to organise assistance, reporting the occurrence at once to the Divisional Officer, and afterwards despatching a second report giving depositions of the subordinates concerned in detecting and extinguishing it. Finally, the Divisional Officer's work in connection with the operations in the Central Provinces is to submit a yearly estimate of next season's new operations immediately after the budget, sending with the estimate sketch maps of the proposed blocks. He then directs the commencement of line clearing operations, sanctions rates for contract* and dates for the completion of the work. When in January line clearing is reported to be over,† the Divisional Officer himself inspects the whole line in detail, and reports it in his diary to the Conservator. Afterwards, if fire occurs he goes himself to the locality, and, after inspecting the burnt area, makes a formal inquiry, in each case submitting a special report to the Conservator. Monthly statements are also submitted to that officer showing the areas under protection, and the dates of the Divisional and Range Officers' line inspections, and the numbers and dates of special reports of the occurrence of fire.

As already stated, the dangerous season is especially from 15th March to 15th May. This is therefore the most anxious time for all concerned, and the Divisional Officer should, during this period, take every opportunity of keeping his men up to the mark by inspecting as much as he can himself, and by keeping up a constant correspondence on the subject with the Range Officers. In Chanda I instituted a system of sending a letter around the line, to be stamped by each peon in transit, and on return to be despatched to the head office. If not looked after, the Protective Establishment gets very lax and fires increase in consequence, for the people around respect our wishes in proportion to our earnestness and strictness. From the 15th May, if the surrounding lands have been burnt over and the lines are thoroughly cleaned, the strength of the patrolling staff can be reduced one-third, otherwise there must be no reduction until the first burst of the rains, when one-half can be discharged, the remainder being kept

* This of course depends on whether the work is done by contract. We believe the daily labour system is generally preferred.

† There are many forests in the Central Provinces in which the grass on the greater portion of the fire-lines is too green to burn until the end of February, and up to the middle of April.

on until the 15th June, unless very early heavy rains saturate the ground and the atmosphere in the meantime.

For the extinguishing of fires some local knowledge and experience is needed to prevent useless expenditure of labor. Once a fire has got complete hold of a grass area nothing short of its burning itself out will stop it. If, then, a fire is approaching through high grass, it is necessary to burn a new fire line ahead of it, or set fire to a spot where it can be controlled and to which it is approaching.

An ordinary fire will not burn at more than a mile an hour except when backed by wind, and then there is no limit to its speed. Such a fire happened in Punasa on the Nerbudda in 1882, and burnt to death six men and a pony who could not keep ahead of it. If the fire is in ordinary jungle it can be beaten out by coolies with leafy branches, and they should watch their opportunity and take united quick action whenever the fire burns low.

It will be found to simplify the work of line clearing if, year by year, the grass which grows in the wet season on the fire lines is carefully preserved from being grazed down by cattle. Once cattle have browsed over it the cutting and burning are never so thorough in the next season.

I would add a few words regarding the accounts of the operations. I have found it useful to keep the account for each block separate as far as possible. In the interest of the forest it is better to know what has been the cost of each portion which is under separate treatment. For most of the forests in Central India there is so little difference in the stock that there is no inconvenience in our making arbitrary limits to areas to be under one treatment; I also separate the expenditure under two heads, clearing and watching, keeping a separate account under the former of line cutting apart from line burning.

E. D. M. HOOPER,
Deputy Conservator of Forests.

THE LAC INSECT ON *FICUS BENGALENSIS* IN GHAZIPUR.

A CORRESPONDENT enquires whether the lac insect only attacks unhealthy trees, or unhealthy parts of trees, or whether healthy trees are liable to be infested by it, and what is the best way of getting rid of the lac insect so as to preserve the tree, as some fine banyan trees at Ghazipur are suffering from its attacks.

In our experience the Coccus attacks the healthiest and juiciest branches, and in Assam is largely reared on the *Ficus cordifolia*, but without destroying the tree, although crops are taken from it yearly.

But the incrustation doubtless impairs the vigor of a tree attacked, and tends to spoil its appearance, and the only remedy we can suggest, is to cut off and destroy all the branches on which the incrustation has been formed, utilizing the lac of course, though this will not guard against its reappearance, as birds or the wind may carry the insects to the tree again. We shall be greatly obliged for any practical suggestions regarding the questions raised.

SPURIOUS GOLDSTONES.

Amongst the interesting and valuable stone ornaments which are sold in India, we often meet a so-called Goldstone which is similar to aventurine. It is a transparent mass with fine reddish metallic scales sparkling in it, and is often sold at a high price.

I have examined one of these stones. It was easily scratched by quartz, and before the blowpipe it melted. With soda I was able to melt out several globules of pure copper. This shows that the stones are a very clever imitation of aventurine in glass, whilst the scales consist of pure copper. Many of the scales are so regularly shaped (in triangles), that they seem almost to have been formed in the glass mixture by crystallisation. These stones are without doubt of European making, and it must be very disappointing if people buy them at a high price in India and send them to their friends in Europe as Indian curiosities.

H. Warth.

Canada Timber Limits.—The Toronto *Globe* states that during the last ten years the Dominion Government has made sale of only two timber limits, one of 400 square miles, which was in 1877, and the other in 1881, when 1,300 square miles were disposed of. For the privilege to cut timber over the last-named area, the Government received 750,000 dols., and that was for limits sold by the old Province of Canada, in ante-confederation times, under the private tender system. Under that regulation the Government received 4 dols. a square mile, but the last sale by the Ontario Government realized 577 dols. a mile.

III. NOTES, QUERIES AND EXTRACTS.

DEHRA DUN FOREST SCHOOL.

THE course of theoretical instruction at the Dehra Dún Forest School was formally closed on the 30th October by the Director, Major F. Bailey, R.E., and the students are now being sent to practical work in the forests under the Superintendent of Forest Working Plans, and the Deputy Superintendent of Forest Surveys, and the Saháranpur and Dehra Dún Forest Divisional officers. Major Bailey after reading out the list of students of the 1st and 2nd years, according to the marks obtained, gave some very sound advice to those of latter who have obtained the Forest Ranger's certificate, and who after two months spent in practical work with the Superintendent of *Working Plans*, will proceed to their several provinces. They were warned against entertaining too high an opinion of their abilities, and advised to respect the views of older officers, who although professionally untrained, have had long experience in the forests, and Major Bailey reminded them that, owing to the shortness of their stay at Dehra, the instruction afforded is more with a view of enlarging the scope of their minds and filling them with useful ideas, than of attempting to instruct them completely in their profession, and that their future, as well as the character of the Forest School, will depend on their modesty of demeanour and on the thoroughness and honesty of the work they may be called upon to undertake, as well as on the practical application of the instruction they have received. Major Bailey's reference to the favorable notice with which Havildar Sadhu Singh is mentioned by the Conservator in the last Punjab Annual Forest Report, was received with applause, and after alluding to the necessity of the students attending to physical exercise during their studies, and to the intention of building suitable quarters for them in the school compound, he brought the proceedings to a close by the distribution of the prizes for athletics, of which the list is given below. The prizes allotted for proficiency in the different subjects taught will consist of suitable books and instruments selected by the students themselves, and will be presented before they finally leave Dehra for their own provinces.

The following is the list of marks obtained :—

2nd Year Final Examination.

Number.	Names.	Provinces.	Botany.	Mathematics.	Physical Sciences.	Forestry.	Law.	Surveying.	First Year's marks.	Monthly Examinations.	Total.
		Full Marks, ...	360	360	360	600	240	300	1,080	960	4,260
1	Jogeswar Súr, ...	Assam, ...	336	300*	360	500*	232	237	979	831	3,775
2	Mahadeo Rao Palnaitkár,	C. Provinces,	336	198	312	530*	240	273	954	801	3,634
3	Charles Ingram, ...	B. Burmah, ...	360*	264	336	340	232	257	950	797	3,536
4	Havildar Sadhó Singh,	Punjab, ...	336	117	288	420	240*	278	929	789	3,391
5	Roghunath Pathak,	Oudh, ...	336	181	312	440	232	271	911	669	3,352
5	Kedar Nath Mozamdar,	Bengal, ..	336	192	264	400	240	262	890	768	3,352
7	Dino Nath Kár, ...	Assam, ...	336	168	264	460	224	261	859	750	3,322
8	Rám Anand, ...	Punjab, ...	312	86	288	460	240	255	927	725	3,293
9	Sundar Lál, ...	Patiála State,	336	76	360*	180	200	278	903	682	3,015
10	Golám Mahomed,	Punjab, ..	168	119	336	340	224	258	788	682	2,915
11	Gurdit Singh, ...	Kapurthala State,	340	95	312	400	216	236	757	615	2,871
12	Bhukhan, ...	Berar, ...	264	106	264	260	168	263	701	561	2,587

The above have all qualified for the Forest Ranger's Certificate.

Six other men attended the course, but have failed to qualify, and their marks have therefore not been given.

In the first year's course, Ranger Tara Kissore Gupta from Assam, is first, and apprentice Har Sarúp of the School Circle, N.-W. Provinces, is second; the former of these students has obtained Mr. E. McArthur Moir's Prize of Rs. 25 for Theoretical Forestry, and Ranger V. S. Goru Natha Pillai from Madras, the Prize of Rs. 15 for Road-making and Building.

The Prizes in the second year are as follows, the marks obtained in the monthly examinations being counted in each subject, as well as those of the final examination :—

* Prize holders.

Theoretical Forestry, Mr. E. McArthur Moir's Prize, Rs. 50—Ranger Mahadeo Rao Palnaitkár.
Ditto, Government Prize, Rs. 30—Ranger Jogeswar Súr.
Physical Science Prize, Rs. 25—Apprentice Sundur Lál.
Chemical Practice Prize, Rs. 15—Forester Charles Ingram.
Botany Prize, Rs. 25—Forester Charles Ingram.
Mathematics Prize, Rs. 25—Ranger Jogeswar Súr.
Law Prize, Rs. 20—Forester Havildar Sadhú Singh.
General Proficiency, Major Bailey's Prize, Rs. 50—Ranger Jogeswar Súr.

During the course many of the students have played cricket regularly, and in the athletics held during the last week, the following prizes were obtained :—

1. Wrestling—
   R. N. Pathak, } *æq.*
   Golám Mahomed, }
2. Cross Country Race, not less than 5 miles—8 started—
   1. C. Ingram.
   2. R. N. Pathak.
   3. Moung Hka.
3. 100 yards Flat Race—
   1. C. Ingram.
   2. Moung Thakadoe.
4. 120 yards Hurdle Race, 8 flights—
   1. Golám Mahomed.
   2. C. Ingram.
5. Broad Jump—
   1. Golám Mahomed, 14 feet 6 inches.
6. High Jump—
   1. Moung Hka, } *æq.*, 4 feet 3 inches.
   2. Gokal Dás, }
7. Horizontal and Parallel Bars—
   1. T. K. Gupta.
   2. Moung Hka.
8. Indian Clubs—
   1. C. Ingram.
   2. R. N. Pathak.
9. Throwing the Cricket Ball—
   1. R. N. Pathak, 88 yards.
   2. C. Ingram, 85 yards 2 feet.
10. Throwing at the Wicket—
    1. Moung Thakadoe.
    2. R. N. Pathak.

Prize for General Excellence in Cricket—
   1. C. Ingram.
   2. Golám Mahomed.

Total value of Prizes Rs. 116, awarded as follows :—

C. Ingram,	... ...	Rs. 53
Go ám Mahomed,	... ...	" 24
R. N. Pathak,	... ...	" 22
Moung Hka,	... ...	" 7
T. K Gupta,	... ...	" 5
Gokal Dás,	... ...	" 3
Moung Thakadoe,	... ...	" 2

Besides the ordinary Students, Mr. D. P. Copeland from Assam, and Mr. Blanchfield from the Central Circle, N.-W. Provinces, have attended the course.

INTERNATIONAL EXHIBITION OF FORESTRY, EDINBURGH

We give below the prospectus of the proposed International Forestry Exhibition to be held in Edinburgh in the summer of 1884. We hope that the Indian Forest Department will be represented, and that some of our officers may be able to attend the Exhibition. The Marquis of Lothian is President of the Executive Committee, in the list of which we are glad to see the name of Dr. Cleghorn, who is also one of the honorary secretaries.

The Exhibition is intended to include everything connected with, or illustrative of, the Forest Products of the World, and will be open to exhibitors of all countries, and all entries close on the 1st March, 1884.

The Secretary is Mr. George Cadell, 3, George IV. Bridge, Edinburgh, formerly of the Indian Forest Department, to whom all intending exhibitors should apply for schedules and forms. We hope shortly to give the schedule of Essays and Reports for which prizes are offered.

PROSPECTUS AND CLASSIFICATION.

CLASS I.—PRACTICAL FORESTRY.

1. Implements, Tools, &c., used in Forestry, Draining, Enclosing, &c ; Surveying Instruments, Chains, Dendrometers, &c.
2. Models of Foresters' Huts, Charcoal Kilns, Timber Slips, Sluices, Dams, Weirs.
3. Plans of River Embankments, Rafts, and Appliances for floating Timber.
4. Models and Machinery for Transporting Timber and Transplanting Trees.
5. Saw-mills—Wood-working and Pulp Machinery of every description, in motion or otherwise.
6. Fencing Materials.

CLASS II.—FOREST PRODUCE, RAW AND MANUFACTURED.

1. Collections of Timber Specimens and Ornamental Woods.
   (*a*). *Indigenous or Naturalised.*
   (*b*). Exotic.
2. Woods used for Ordnance—as Gun Carriages, &c.
3. Woods used for Railway Purposes, Natural and Prepared.
4. Wood Pavements.
5. Cooperage—Tubs, Barrels, &c.
6. Wood Carving and Turnery, with Tools used.
7. *Basket and Wicker Work.*
8. Fancy Woodwork, including Bog Oak, Veneers, Parqueterie, Stained and Coloured Woods, &c.
9. Wood Engraving.
10. Bamboos, Canes, Reeds *and Manufactures therefrom.*
11. Tanning Substances—Barks and Extracts.
12. Dyeing Substances—Woods, Roots, Flowers, &c.
13. Barks, including *Cork.*
14. Fibres and Fibrous Substances.
15. Materials for Paper Manufacture.
16. Gums, Resins, and Gum Elastics.
17. Wood Oils and Varnishes—including Lac of sorts.
18. Drugs, Foods, Spices.
19. Charcoal for Gunpowder, Tinder, &c.
20. Peat and its Products.
21. Cones, Seeds, and Fruits of Trees and Shrubs.

CLASS III.—SCIENTIFIC FORESTRY.

1. Botanical Specimens of Forest Flora.
2. Microscopic *Sections of* Woods.
3. Parasites—Fungi and Lichens injurious to Trees.
4. Forest Fauna injurious to Woods.
5. Entomology.—Useful and Noxious Insects, and damage produced—as Pine Beetles, Weevils, &c., Coffee Borers, White Ants, Moths, Carpenter Bees, Locusts, &c., with Specimens, as far as possible, illustrative of the specific damage done by them.
6. Preservative Processes applied to Timber.
7. Geological Specimens and Diagrams illustrating the different formations adapted to the Growth of Trees.
8. Fossil Plants—Collections illustrative of the Trees of Coal Measures, &c.
9. Trees found in Bogs—Oak, Fir, &c.

CLASS IV.—ORNAMENTAL FORESTRY.

Growing Specimens of Rare and Ornamental Trees and Naturalised Species—in tubs or otherwise. Rustic Work—Arbours, Bridges Seats, &c.

CLASS V.—ILLUSTRATIVE FORESTRY.

Paintings, Photographs, and Drawings of Remarkable and Historical Trees—Foliage and Scenery.

Delineations of Trees in their Native Countries, or of Recent and Important Introductions.

Illustrations or Photographs showing Effects of Blight, Accident, or any Abnormal Condition, including those of Parasitical Plants.

Sketches of Work and Operations in the Forests.

N.B.—*Special attention is invited to this Class.*

CLASS VI.—FOREST LITERATURE AND HISTORY.

1. Reports of Forest Schools—Forest Periodicals and other publications—Manuals and Almanacs—Treatises on Measuring and Valuing Woods—Forest Floras of different countries—Treatises on Fixation of Dunes, and on Ancient or Extinct Forests.
2. (*a*). Working Plans of Forests, and Plantations on Estates, Valuations, Surveys, &c.
   (*b*). Maps—Charts, &c., illustrative of the Geographical Distribution of Forest Trees, and their Altitude.

N.B.—*Special attention is invited to Section 2.*

CLASS VII.—ESSAYS AND REPORTS.

Essays and Reports on Specific Subjects, for which Premiums are offered as per separate Schedule.

CLASS VIII.—LOAN COLLECTIONS.

CLASS IX.—MISCELLANEOUS.

JAPAN LACQUER.—We extract the following from a paper in the "Edinburgh Review" for April, on Dr. Dresser's book on Japan, and as both the *Rhus vernicifera* and *succedanea* are either found in or may be introduced into the Himalayas, there should be no reason against introducing the lacquer industry into India.

"The tree from which the vegetable extract that forms the basis of lacquer is obtained (the *Rhus vernicifera*) is found on the Asiatic Continent, but is said to flourish best in Japan. The tree is diœcious, and wax is extracted from its seeds, as well as from those of the *Rhus succedanea*. The lactiferous vessels, unlike the wax, are found in both the staminiferous and the pistiliferous trees. The quality of the lacquer depends in some

degree on the nature of the soil in which the tree grows. Incisions are made in the stem, the punctures being repeated every fourth day at successively higher parts of the tree. The juice which oozes out is scraped off with a flat iron tool. When the tree has been thus tapped to the topmost branches, it is felled. The log is cut into lengths, which are tied into faggots, and steeped in water for from ten to twenty days; after which the bark is pierced, and the oozing lacquer is collected in the same way as from the stem. One or two plants besides the true cultivated lacquer tree also produce both lacquer and vegetable wax.

"The juice thus collected is a tenacious fluid of a greyish brown color. It is allowed to stand and settle when first obtained. A kind of skin forms over the surface; the better quality rises to the top and the impurities sink to the bottom. It is thus easy to separate the finest from the inferior qualities, and the former are strained through cotton or porous paper. By stirring in the open air the lacquer partially dries, absorbs oxygen, and gains a brilliant dark color. In the fluid state it is highly corrosive, and if a drop fall on the skin, it will produce a serious sore, often eating its way to the bone. There is even said to be a particular kind of fever caught in the lacquer manufactories. Not however that any special buildings are used for this industry, which is carried on in ordinary houses.

"The lacquer workers kneel on the usual matted floors, and the chief care taken is to keep the apartments clean, and free from dust. The lacquer is spread on the substratum employed, which is almost invariably wood, in coats of successively increasing fineness; the first coat usually being mixed with powdered earth. Each coat when dry, is rubbed down with a cutting stone. In an object intended to be of excellent quality, as many as eleven coats are thus laid on, before the decoration is commenced. After the application of the last coat, the surface is ground down with lumps of hard charcoal, which are kept wet, and the final polish is given by the ashes of deer's horns.

"The pattern to be borne by the object is sketched in outline in lacquer upon fibrous elastic paper; the paper is warmed, and fitted to the surface to be decorated, and the pressure of the hand is enough to transfer the pattern, after which the paper is removed. If the pattern is to be in gold, the outline is then followed by a fine hair pencil, dipped in lacquer, which is intended to act as a size. When this has so far dried as to be sticky, fine gold dust is shaken on it from a spoon. The gold dust looks grey at first, but its yellow color is brought out by burnishing. As an illustration of the almost infinite minuteness of this kind of work, Dr. Dresser describes a little medicine box three-and-a-quarter inches long, two-and-a-quarter inches wide, and seven-eighths of an inch in greatest thickness, which is decorated with fifty-nine heads of flowers, each of which is

half an inch long and three-sixtenths of an inch wide. On each eighth of an inch square of these flower heads are about one hundred and twenty distinct pieces of gold, making six hundred for each head, or above thirty-five thousand on the box. In addition to these flowers, the little heads of grass on the box are also tipped with these little golden squares."

Many other interesting details are given regarding the lacquer industry, for which we have no space. It is well to mention, however, that a moist atmosphere is said to be necessary to insure drying without cracks. The extreme humidity of Japan in certain seasons and localities, is probably a condition for the execution of large lacquered surfaces of temples.

Regarding paper making, it is said that—"The range of paper making in Japan is extraordinary—reaching from substantial roofing substitutes for tiles or slates, or the rough tarpaulin *the Japanese wear in the winter, to the most delicate lace-like* fabric for kerchiefs or personal under-garments.

"The pulp is made from the paper mulberry and five or six other plants, and it remains to be ascertained, first, how far these precious plants can be reared in any European district; and secondly, how far their bark, wood and juice may be susceptible of use if exported, whether in the raw condition or in a partially prepared state."

The following extract from the "Indian Agriculturist" shows what is being done to extend the cultivation of the *Rhus vernicifera*, and we shall be very glad to receive any further notes on the subject.

"In a letter to Sir Louis Mallet, Mr. W. T. Thiselton Dyer, Royal Gardens, Kew, says:—I am desired by Sir Joseph Hooker to draw your attention to the steps which have been taken by this establishment to obtain information as to the lacquer industry of Japan. As you are aware, its products are highly esteemed by all lovers of art, but up to the present time practically nothing has been known as to the methods by which such beautiful objects are obtained.

"From the statement of Kämpfer (1712), it has been accepted by botanists that the *varnish*, which is the basis of all lacquer work, was obtained from incisions in the three-year old stems of a tree indigenous to Japan, known as *Rhus vernicifera*. Beyond the fact that the tree is cultivated as coppice-wood, the information of Kämpfer does not go, and up to the present time our knowledge of the subject has been a complete blank. Thus Balfour in his Cyclopædia of India (1873) states that 'the manner of preparing it (the varnish) and the mode of applying it, is and is likely to remain a secret.' It had been supposed that the Japanese lacquer tree was identical with a common Himalayan species of *Rhus*. Dr. Brandis points out, however, (Forest Flora, page 121,) that the Himalayan tree is not 'known to yield any varnish;' and Sir Joseph Hooker in elaborating the *Anacardiaceæ* for the Flora of British India (ii, page 11) has, in describing it under the name of *Rhus Wallichii*, decided that it is not identical with the Japanese species. The lacquer varnish tree of that country

is apparently unknown in India. It seems worth while, therefore, to draw the attention of the Government of India to the fact, as seed could doubtless be easily obtained from Japan, and there are many parts of India in which the tree could be cultivated.

"In its lac industry India possesses an art which is closely allied to that of lacquering. It can scarcely be doubted that the latter is equally adapted to the methods and habits of the natives. Its results are, in an economic point of view, infinitely superior to those in which lac is used.

"At the instance of Sir Joseph Hooker, the Foreign Office caused an elaborate inquiry to be made by its officers in Japan into the whole subject. The result will be found in a report by the Acting Consul at Hakodate, dated Tokio, January 13, 1882, which has been printed and laid before Parliament. I am now to suggest that copies of this report, together with this communication, should be printed and transmitted to the Government of India, in order that some attention should be attracted to the subject in that country.

"The very complete collection illustrating the report has been transmitted to Kew and exhibited in the Museum of Economic Botany. It has been pronounced by experts in Japanese art to be of exceptional interest and quite unique of its kind. A portion of the expense incurred by the Foreign Office in getting it together has been defrayed from the grant made to this establishment by the India Office for the sustentation of the economico-botanical collections relating to India.

"I am desired by Sir J. D. Hooker to inform you that he received from Mr. Quin, Acting Consul at Hakodate, a small quantity of seed of the Japanese lacquer tree, *Rhus vernicifera*. Portions have been transmitted to Saharanpur and Madras for experimental cultivation. Mr. Quin states that these particular seeds were obtained 'from trees which undergo a very severe winter, being almost buried in snow for several months.' The tree, however, will doubtless do equally well in a less rigorous climate. Mr. Quin further states that the wax used in the north of Japan is all made from the berries of *Rhus vernicifera*."

THE ASSAM SUGAR-MILL.—The following account of the common Assam Sugar-mill is taken from a report by Mr. Stack, Director of Agriculture in Assam:—This instrument (called *kherkha* in *Goálpára*, and *hál* in Upper Assam) is a rude but tolerably effective machine, and a quicker and less dangerous worker than the heavy beam-and-pestle arrangement of Upper India.* It consists of two vertical rollers (*bhím*) placed in juxtaposition, with their lower ends resting in a flat trough (*bhordí*) scooped in a solid and heavy block of wood (*toljoli*)

* Messrs. Mylne and Thomson claim for their Bihia mill the power of crushing thrice as much cane in a given time as the common *kolhu* of Behar and the N.-W. Provinces. Their calculations (which are supported by independent experimental evidence) make the average outturn of the *kolhu* about 100 lbs. per hour. The Assamese mill works at least half as rapidly again.

resting on the ground, while their upper ends pass through a rectangular space cut in a horizontal beam above (*borjoli*) supported by uprights (*hol khuta*) let through the lower block into the ground. The rollers are held in their places by vertical clamps (*ghará*), which grip them at the upper and lower ends, and are driven home by wedges (*khál*). The portions of the rollers which project above the upper beam (*borjoli*) are grooved so as to work into each other on the principle of an endless screw. The driving power is a horizontal beam (*kitari*), applied to the head of the taller or "male" roller (*máta bhim*), upon which the shorter or "female" roller (*maiki bhim*) revolves in the contrary direction.* The "male" roller is usually, if not invariably, that on the right hand as one faces the mill, and the direction of progress is from left to right, that is to say, the men at work walk round with the left shoulder inwards. Buffaloes are seldom yoked to an Assamese sugar-mill, and bullocks never. The whole machine is made entirely of wood, without a nail or a piece of iron in its composition, and its value varies according to the kind of wood used. A mill can be built of tamarind wood for Rs. 8, but in *jam* wood (*Eugenia Jambolana*) it will cost Rs. 12, and if *nahor* (*Mesua ferrea*) is used, as much as Rs. 15.

All being ready for crushing, the first thing the cultivator does is to bind two of the finest cane stalks along the beam of the mill, as an offering to Viswarkarma, the god of artificers. The canes are then passed through the mill in batches (*aná* or *kand*) of six or eight at a time, the juice falling into the trough, and thence through a hole on to a sloping wooden tray, which transmits it by a lip of plantain leaf to the earthen vessel placed to receive it in a pit dug below. In some places the tray (*ras-dhara*) is circular in shape, with a raised wooden edge and a

* The following are the dimensions of a sugar-mill measured in the Májhuli, and may be taken as fairly representative of the machine commonly used in Assam.—

	Length. Ft.	Length. In.	Breadth. Ft.	Breadth. In.	Thickness or depth. Inches.
Tolyoli, ...	4	0	1	3	$3\frac{1}{2}$
Trough scooped in *tolyoli*, ...	2	0	0	$7\frac{1}{2}$	$2\frac{1}{2}$
Borjoli, ...	6	6	1	$2\frac{1}{2}$	6
Rectangular space in *borjoli*, ...	1	11	0	9	6
Total length of rollers, ...	3	6			
Circumference, ...	2	$4\frac{1}{2}$			
Length of grooved part, ...	1	1			
Breadth of grooves, ...	0	$2\frac{1}{2}$			
Depth of "	0	2			
Height of uprights, ...	9	6			
Circumference, ...	2	4			

The length of each arm of the beam was about 9 feet.

The smooth or ungrooved portion of the rollers was thus 2 feet 5 inches in length, but from this must be deducted the spaces covered by the depth of the trough below and the thickness of the *borjoli* above, *i.e.*, $2\frac{1}{2}$ inches and 6 inches: thus, 2 feet 5 inches − $8\frac{1}{2}$ inches = 1 foot $8\frac{1}{2}$ inches, the length available for crushing.

funnel-shaped escapement for the juice, but usually a simple slab of wood, slightly concave, is considered sufficient. The working of the mill is accompanied by a loud and strident noise, which is welcomed by the ryots as a sign that the rollers are biting well, and is, moreover, a cheerful and useful accompaniment while the work is carried on by night, as is the practice towards the end of the season, when the heat of the day would be injurious alike to the men and the cane-juice. Each handful of canes is passed through the mill three or four times, until they begin to yield mere foam, when they are thrown aside, and a fresh batch takes their place. *Mugi* and *pura* cane squirt out their juice plentifully on the first compression, and give less afterwards, while the harder and tougher *teliya* passes through almost dry, and only begins to yield juice to the second squeeze. At the third and fourth crushings, the flattened canes are usually twisted into a rope, so as to present a bulkier body for compression. A boy sitting in front of the mill draws them out as they pass through the rollers, and hands them back to the man who sits behind and feeds the mill. Four or five men drive the machine, resting their hands on the beam, and pushing against it with the chest and shoulders. The force required to put the mill in motion was ascertained in one experiment made by Mr. R. T. Greer, sub-divisional officer of Golághát, to be 5 to 6 lbs. without cane, and 40 lbs. with *mugi* cane between the rollers, but 60 lbs. with *teliya*. The rate of progress in crushing is about two maunds (165 lbs.) per hour. A good deal of trash and impurity—earth from the imperfectly cleaned canes, fragments of the stalk, dust carried by the wind, &c.—enters the earthen pot along with the juice; in fact, after a couple of hours' work, mud can be plentifully scraped off the plantain leaf lip of the tray, but the ryots seldom trouble themselves to clean it. When the pot is full, it is changed for another. As the work proceeds, the wedges holding the clamps have usually to be driven home from time to time, to counteract the tendency of the rollers to work asunder.

THE following is extracted from Mr. Risley's report on the Trade of Chota Nagpore, with reference to the proposed railway from Sitarampur.

The gradual spread of cultivation, the incessant demand for railway sleepers, and the practice of girdling the tree for resin, have combined to denude the districts of Hazaribagh, Lohardugga, and Manbhoom of most of their valuable sál forests. Extensive jungles still remain uncleared in these districts, but nearly all the trees big enough to make sleepers have been thinned out, and little besides saplings is left. Forest reserves have been formed by Government in the north-west of Hazaribagh, in the south of Palamow, and in the western corner of

Singbhoom, and throughout the division the landholders are now beginning to establish small reserves locally known as *rakhwats*. These, however, are not worked on any regular system; their boundaries are usually ill-defined, and the conflicting claims of the landlord and the villagers are a fruitful source of litigation in the criminal courts. A scheme for preserving the private forests of Chota Nagpore has recently been under consideration by Government. Forest officers were deputed to examine the forests, but it is believed that, except in Singbhoom, which has only been resorted to for sleepers within the last two or three years, and in the south of Lohardugga, the private forests of the division contain little timber worth preserving. In the Tributary States the original forests are still virtually untouched. Cart-roads do not exist, and the rivers cannot be used for floating timber. Here the proposed railway will open out an enormous area of virgin forest which, if properly worked, ought to meet almost any demand for an indefinite period.

THE CORK OAK IN NEW ZEALAND.—In a paper read before the Auckland Institute, Mr. Justice Gillies gives the following particulars:—In 1855 the late Dr. Sinclair planted a young Cork Oak received from Kew. It is now 40 feet high, 14 feet in bole, with a crown of about 40 feet in diameter. The trunk at 3 feet from the ground is now 5 feet 9 inches in girth after stripping. For several years it has produced acorns, from which the present occupant of the grounds, Mr. John Hay, has raised a number of young oaks, and distributed them liberally through New Zealand. In 1877, I stripped the tree for the first time, and got a large quantity of virgin cork, which I did not weigh, the first stripping being of no commercial value. In February last, I again stripped it, and after drying the bark found the product to be 70 lbs. weight of good marketable cork fit for pint corks, and said to be worth 60*s.* per cwt. It will thus be seen that the trees must be twenty-five to twenty-seven years old before producing any return, and then every five years may produce 70 lbs. to 100 lbs. weight of marketable cork. The produce improves in quality with each stripping. On comparing the New Zealand product with imported bark, it is evident that the annual growth of the bark in Auckland is equal to that of the imported.—*Gardener's Chronicle.*

THE TREATMENT OF RUBBER: IMPORTANT FOR PLANTERS.—Mr. T. Christy of London writing on 9th August with reference to "R's" letter on page 615 of the *Tropical Agriculturist*, says:—

"I am delighted to see some people are waking up, and I am glad to let them know how far I have got in regard to the treatment of *milky gum*. As soon as the milk is collected, weigh out

a pound or any given weight, then get some cheap spirit. If the strength can be discovered so much the better. When all is ready pour in some spirit on the mi.k, and if watched, and of the proper strength, all the *rubber* or guttapercha will run up in veins to a lump. Of course the less spirit used the better : then note the quantity of spirit required and write it down. Take the ball of rubber and put it into clean water and wash it as you would butter, and put it to dry in cakes in the sun. This washing gets rid of the resin and gum that cause the 'elastic' gum to be brittle. Some sort of gutta I have found go quite hard when treated. I have tried alum and on some 'milks' this has an effect, but I do not get so large a yield of elastic gum as with spirit."—*Timber Trades Journal.*

TEAKWOOD.—*I understand, says a writer in the Garden, that* some of our enterprising hot-house builders are introducing this wood into horticultural buildings, and it is expected it will supersede pine to a considerab.e extent. It is light, strong, and durable, and not difficult to work. Teak baskets for orchids are now common, and gardeners know how much more lasting they are than those of hazel and other common woods. Lightness and elegance of structure are important considerations in hot-houses in more ways than one, and in this respect teak has the decided advantage, for it enables the builder to dispense with heavy rafters and beams, and is not much less durable than iron, to which it is preferable in other respects.—*Timber Trades Journal.*

"A large consignment of American skewers just to hand," is an announcement which is prominently exhibited in proximity to the markets in our large towns. Why cannot our saw-mill owners in the home timber trade use up a little more of their waste material for such-like small articles, instead of consumers having to send 3,000 miles for them ? These American skewers are better looking than the rough hewn ones to which we have been accustomed, but certainly not so well suited for butchers' purposes. They look more like ready-sharpened pencils, having been turned smooth and pointed by machinery. We suppose, however, that the introduction of these American skewers is due to our national backwardness in making use of labour-saving machines for small industries. Skewer-making in Shakespeare's time was carried on by hand in this country, and is still to a great extent. The processes of the manufacture are generally believed to have suggested the following lines :—

> "There's a divin.ty that shapes our ends,
> Rough hew them how we will"

—*Timber Trades Journal.*

THE following extracts from the "Cape Times," shows that the importance of securing a supply of local forest produce is appreciated by the Government there. Mr. Hutchins of the Indian Forest Department, lately transferred from Mysore to Bengal, and now employed on special duty at the Cape, is the officer referred to.

"Honorable Mr. Pritchard moved: That there be laid on the table of this Council a return, showing the imported cost of all articles made; of wood contracted for by the Government out of this colony, such as railway carriages, railway trucks, tipping carts, Scotch carts, wheel-barrows, railway sleepers, pickaxe handles, &c., imported during the year ended the 30th June, 1883. He desired to obtain this information in order that it might be compared with the report of the committee of another place which was now sitting on the question of colonial industries.

"Mr. Robertson's resolution on the use of yellow-wood for railway sleepers, and the encouragement of colonial woodcraft, was agreed to in committee. What will come of it? A select committee two years ago recommended certain tests and experiments with reference to the use of yellow-wood for railway sleepers; and a fortnight ago some sleepers cut from Knysna timber were shipped to England to be tested. Mr. Robertson's resolution will have the same fate. There are at present in the country sleepers of creosoted yellow-wood that have lain for many years. Is no evidence to be collected from these? And what says Comte Vaselot de Regné? Yellow-wood, experts say, is one of the hardest and most durable of timbers, if cut at the proper season and dealt with *secundum artem*. Stink-wood is of quicker growth, and might be multiplied indefinitely if the work of re-forestation were actively and skilfully pursued. If Mr. Robertson had brought to the notice of the House the state of the Forest Department and its need of more liberal treatment, he would have done more good than by a resolution which will straightway be pigeon-holed in a department. The Comte Vaselot de Regné has lately been reinforced by one experienced and clever forest officer from India; but this branch of the service is undermanned. It is trite to say that not for the sake of timber only the colonial forests should be kept under careful and intelligent control, and planting industriously carried on wherever the conditions of soil and site are favourable. The effect of forests on climate is known to every school-boy."

SOME experiments in manufacturing potash have been made by Dr. Warth at the Debra Dún Forest School, and 250 maunds of undried sál wood yielded 3 seers of potash.

THE

INDIAN FORESTER.

Vol. IX.] December, 1883. [No. 12.

COCHINEAL.

[The information in this paper is derived partly from Liotard's *Memorandum on Dyes of Indian Growth and Production*, partly from the *Proceedings of the Agricultural Department*, October 1871, and partly from notes supplied by Lieut.-Colonel Wace, Commissioner of Agriculture, Punjab.—J. S. C. D.]

I.

The Cochineal insect is known scientifically as the *Coccus cacti*, being nearly allied to the lac insect, or *Coccus Lacca*. It is found in the wild state in many countries, but in Mexico and the Canary Islands has been much improved by rearing and selection. The object of the present notice is to describe the methods of rearing employed in these countries, to give some description of the cochineal dye, and to point out the great facilities which exist for cultivating the insect in India without difficulty and with much profit. The Cochineal insect is met with of two varieties, the *grana fina* and the *grana sylvestris*. The latter variety is wild, and is inferior to the *grana fina* or Mexican or *Mestique* variety, which alone seems to be commercially profitable. In the Canary Islands the *grana fina* has been introduced with much success, as will be seen from the following descriptive report furnished by Mr. Grattan, British Consul in the Canary Islands.

The Cochineal insect is a species of *coccus* about the size of a pea; it has a silvery grey appearance, the body being reddish black and covered with fine white dust. When first brought forth, the insect moves about freely, but as it grows it fixes itself to the leaf from which it derives its nourishment. There are several varieties of the prickly-pear plant on which the Cochineal feeds, but that most generally cultivated for the purpose of breeding, is the common hardy *Opuntia vulgaris*. In a wild state this plant brings forth abundance of fruit, and it formerly supplied one of the principal articles of food to the inhabitants of the Canary Islands. The fruit is found to debilitate the plant when

used for the purpose of rearing Cochineal; it is therefore carefully removed as fast as it buds. The cactus plant is so hardy as to grow luxuriantly on rocky spots, where there appears to be scarcely soil enough to fill the crevices; but in this state it cannot serve for the rearing of Cochineal for more than one or two seasons. In rich soil, and with abundance of manure and water, the same plants will continue to yield excellent crops for from 10 to 12 years.

The best soil is that which is found in volcanic countries, where pumice stone and black *scoria* abound. Where no artificial irrigation can be obtained, a layer of black *scoria*, called locally "picou," covering the ground to the depth of several inches, is found greatly to improve the plant, by retaining the moisture of the soil, and protecting it from the heat of the sun, and also by preventing the growth of weeds, thereby keeping the land constantly clean. In those parts of the Canary Islands where the soil has been overrun by lava, and on which the vegetable growth is confined to lichens, mosses, and here and there small ferns or weeds, the preparation of the land for the cultivation of the cactus is a long and costly process. The rocks and stones which cover the surface being removed from a given space, the earth and mould buried beneath them is carefully collected into a mound; the rubbish is then replaced, forming a flat surface, and the earth is spread on the top to the depth of at least three-quarters of a yard. The expense of this process varies according to the hardness of the rock, to the abundance of sub-soil, and to many other circumstances. When the lava streams of older date, and the crumbling action of the elements has softened and rendered the stone porous, the mould beneath being found in sufficient abundance; the average cost of preparing the land for cactus planting is about £90 to the acre. Where there is abundance of earth on the surface, and the preparation consists only in levelling the ground for the facility of planting and of irrigation, the cost is much less; but a thorough upturning and airing of the soil is found to be essential to the successful cultivation of the cactus. The cactus plant is propagated by the leaves, which should be broken off sharply one at a time, and be exposed to the heat of the sun for about three weeks before they are planted; if the leaf is put into the ground fresh and moist as at first gathered, it is almost sure to rot; but when laid in the sun, and allowed to dry until slightly bent, it will strike root and bud with the greatest facility. During the summer months, leaves so dried will be found to bud in ten days or a fortnight with great profusion, as many as eight or ten new leaves bursting forth at the same time. The leaves should be planted in furrows at about a yard apart, either edgeways, as close as possible, or about 4 inches apart if placed across the furrows. This plantation being made in May or June, the new leaves will have grown to their full size in four

or five months, and the plants will then be ready for transplanting into the ground to be finally allotted to them. Here the furrows should be at least two yards apart, in order to admit of a free passage to the labourers amongst the plants after they have grown to their full size; and each plant should be placed in the furrow at half a yard from that on either side of it, in order to allow sufficient space for their full development, which will take place in the month of February or of March. Each leaf buds with about from 5 to 15 shoots, according to the nature of the soil and to the quantity of manure and water supplied to it. In handling these plants, great care must be taken to avoid bruising the main trunk; if by accident the hoe should be struck against it, the only way of saving the plant is to cut out the injured piece with a sharp knife, the fresh cut will then probably dry, and the plant will be none the worse; a bruise, on the contrary, gradually causes the whole trunk to become soft and putrid. A considerable quantity of ordinary manure or of guano is required to bring the plants to perfection, the latter is dangerous without abundant irrigation, the plants being subject to a peculiar disease when there is not sufficient water to dissolve the guano; but with plenty of water as much as 20 cwt. of guano can be applied to each acre of cactus plants with the best results. In all cases, however, it is found advantageous to make use of ordinary manure, as well as guano, in order to lighten the soil, which should be thoroughly dug four times a year, and oftener when weeds are plentiful.

Having by these means by the end of May or June, obtained well-grown cactus plants consisting of four or five branches springing from each trunk, with a good supply of rich dark-green leaves; when the fleshly spines and prickles have fallen from them, the plantation is ready to receive the insect. The growers on the south side of the Island of Teneriffe cultivate the Cochineal in the winter, so as to bring it to maturity in time for the great crop which is planted from the latter end of May to the end of July or August; the insects being carried to the north of the island in boxes supplied with trays, in which they are laid to the depth of two inches. Each box is constructed to hold about 40 lbs., and is carried on a man's shoulders over the mountains during the night, so as to be as little exposed to the heat of the sun as possible. In Grand Canary the most extensive planters reserve a portion of their land for the production of "madres" (or mothers) as will be hereafter explained. The state of the weather during the growth of the "madres," and the temperature at the time of spawning, has so great an effect upon the amount of young produced, that it is impossible to fix the quantity of "madres" required per acre; but for such a plantation as has been described, about from eight to ten boxes, that is from three to four quintals, would be considered a fair average. The mothers are put into small bags

made of a material called "renique," (a sort of gauze,) about 8 or 9 inches long, and shaped somewhat like a sausage, in each of which is put about a table-spoonful of "madres," and then hung over a leaf in the Cochineal plantation. The young, as they are born, walk out of the bag on to the cactus, and spread over the surface of the leaf. The quantity of insects spawned in a given time will vary according to the heat of the weather, and the age of the "madres"; with fresh "madres," and in warm weather a couple of hours will be enough to cover the leaf sufficiently with old "madres," and in cold weather, the bags may be left on the leaves as long as 30 hours, or even two days; the leaf, on removing the bags, should be moderately and evenly covered with insects. If the insect is allowed to spawn too freely on each leaf, the crop will be damaged in quality, and if the bags are removed too soon, the crops will be deficient in quantity. The obtaining of fair average number of insects on each leaf is therefore one of the most important points to be looked too in the cultivation of Cochineal, and one which requires experience and constant supervision on the part of the grower. There are other ways of conveying the spawn to the leaves; that most in practice is the following: the "madres," are spread on shallow trays which are slid into shelves round a room, each tray being being about 4 or 5 inches long and 2½ inches wide; some use them made entirely of wood, others a framework of wood with a bottom of "medio brin," or thin canvas, nailed on so as to prevent the escape of the young. The "madres" being laid thinly over the surface, so as to lie closely side by side, but not one over the other; pieces of rag, about half a yard long by 5 inches wide, are then spread over the whole surface of the tray; in a short time these become covered on the under-side with the young insects, and being removed are conveyed to the plantation in baskets; they are one by one pinned on to the leaves, on which the young insects soon fix themselves; fresh rags are then laid over the "madres" to be again covered with the young. It is found that white rags are best, black and dark colours are *disliked* by the insect. The same difficulty as to the number of insects conveyed to each leaf exists in this method of rearing as well as in the former with a new element of difficulty, *viz.*, that the production of the young varies with the amount of light admitted into the room. To insure the greatest quantity of spawn in the shortest time, it is therefore necessary to have a skylight to the room, and it is not improbable that the preference for white rags is owing to their admitting more light to the insect. After pinning the rags to the leaves they are left for a longer or shorter time, according to the state of the weather; in fine and warm weather 24 hours will suffice, but when the weather is cold and damp they should not be removed for three, four, or more days. In the winter season the rags used formerly to be left upon the plants until the time for

gathering the crops, in order to protect the young insects from the inclemency of the weather, but experience has shown that this object is better obtained by other means. It may be as well to mention here, that for a winter crop the insects should be allowed to spawn far more copiously on each leaf than in summer, as the cold, rain, and winds of that season destroy a great many. When the "madres" have exhausted their powers, which occurs sooner or later, according to the temperature to which they are exposed, and which is known by the young being born black instead of white, they are collected from the bags or trays in which they have been spawning and put into an oven for drying. This process, and the treatment used in preparing the "madres" for market, is so similar to that gone through with the full-grown silver Cochineal of the principal crop, that both subjects may be considered together. The young insect takes more or less time in coming to maturity, according to the weather. Those reared in June are often ready to be gathered in 70 days, or even earlier; whereas those reared in October and November are not ripe till late in February or early in March. Those reared in the latter season, which are intended exclusively to serve as "madres" should be allowed to ripen thoroughly before they are gathered, and should not be taken off the plant until there are some young to be seen crawling over the leaves. On the other hand, the Cochineal reared in March or April for "madres" spawns with such astonishing rapidity in June or July, under the influence of the heat of those months, that, as soon as the first leaf in a plantation which has taken three or four days to cover with insects is seen to have young upon it, the whole should be gathered, for even those that require some hours before arriving at maturity will ripen in warm weather.

The Cochineal reared in June and July being the great crop of the year, prepared principally for drying at once into silver Cochineal, should be gathered before it commences to spawn. Thus, during August and September, the grower watches for the first symptoms of spawning, and as soon as they are noticed, not a moment is lost in proceeding to immediate gathering, for the weather being then quite as warm and bright as in June, the same rapidity in ripening is observable, and the loss of weight is serious if the spawning is allowed to proceed for even a few hours. The proper manner of gathering varies according to the object to which the plants are devoted; but, as a general rule, the leaves on which the bags are placed are sharply cut off with a knife, close to the branches, and the Cochineal is swept off them into broad baskets closely woven to prevent loss. After the leaves are all cut off and swept, they are dropped into the ridges, *where they are left*; another set of gatherers carefully scrape off the insects which have passed into the branches or trunk of the plant; leaving even one or two insects on these branches is fatal to the health of the plant, as they spawn, most probably in hidden spots,

and shortly afterwards the strength of the branches, which is required to produce new leaves for the ensuing year, is absorbed by the surreptitious growth of insects, and this is fatal to the future crop. It is, therefore, a most important point to be attended to by the overseer. To prevent any young insects remaining on the plants after gathering, it is necessary to sweep the branches several times every two or three days. By this means such as may escape the first or second sweeping, having both grown and changed their position, will be removed on the third or fourth application of the broom. It must be borne in mind that a small insect will grow in a few weeks into a "madre," and will propagate several hundreds of young which will eventually much weaken the plant. The leaves which have been cut off at the gathering of the crop, should now be chopped up into small pieces and dug into the ground, as they serve to lighten it, and by their fermentation they warm the roots of the plant, and act as excellent manure; guano should also be applied freely. It is found that as much as 15 quintals of guano per $1\frac{1}{4}$ acres can be applied with benefit to the Cochineal, a grower at Grand Canary used as much as 25 quintals on one occasion, and was rewarded by a return of from 11 to 12 quintals of Cochineal, or nearly double the average crop. To prevent so much guano injuring the plants, artificial watering must be freely resorted to if necessary; a good soaking being given to the ground every three weeks. The cactus cannot bear much water when not strengthened with manure, neither can it bear much manure unless it is copiously watered. When a plantation is reserved for the production of a winter crop, the leaves should be covered with Cochineal in the months of October or November, by planting the young Cochineal at this season, it ripens, and is ready for gathering at the latter end of February or of March. Another plantation of cacti is reserved for receiving the seed at this season; but as the plants cannot be forced to bud during the winter, the seed must be planted in March upon last year's leaves, which have the disadvantage of being tough for the insect, and this renders a winter crop more precarious than one obtained in summer; however, the sale of "madres" in June brings a quicker return than the dry crop of August or September. The wind and rain during the winter months frequently destroy half the crops, and in summer a hot south wind ("levante") will often kill many of the insects. In order to prevent the losses thus occasioned, a light covering of cotton gauze is spread over the whole plantation upon stakes and wires, at a height of about 7 feet. Mats have been used for the purpose, and also calico, but these materials are found to injure the insects during the winter by keeping off the sunshine, and in summer by preventing the free circulation of air. Some growers protect the insects by merely throwing mats loosely over the plants when the weather threatens to be very hot or stormy, removing them when the danger

has passed. But these are only make-shifts, and are less efficacious than the first-mentioned plan. The evil effects produced by the heat during a south wind in summer may be much diminished by a copious watering early in the morning, for the moisture which evaporates from the wet soil saves many of the insects. As the Cochineal is collected, care should be taken that the baskets do not remain long filled, the insects that lie at the bottom being injured by the weight. The person in charge should immediately empty the baskets on receiving them from the plantation, and spread out the Cochineal on trays, or even on a sheet on the ground, not deeper than from 2 to 3 inches, otherwise the grain will assume a reddish tinge, which considerably diminishes its value. The Cochineal gathered during the day is collected in this way, and towards evening it is put into an oven heated at about 150° Fahrenheit; there it is left for four or five hours, the temperature being carefully kept up; afterwards the oven is allowed to cool gradually until the morning, when it will be found that the insects are still moist. Exposure to the sun for a few days in summer will complete the drying, and it is found that there is less loss of weight when the Cochineal is dried in this manner than would occur if subjected to greater heat, or if left a longer time in the oven in order to dry it at once; even in winter many growers prefer to let their Cochineal dry slowly in the air rather than by the heat of the oven, the loss of time being of less importance than the loss of weight. Some growers do not use the oven; a table-spoonful of wood-ashes is spread over a pound or two of Cochineal, it kills it in a couple of hours; the dust and ashes are then shaken off from the grain in a sieve, and the Cochineal is dried in the sun. Others prepare the Cochineal by putting it into sacks in moderate quantities; two men grasp the sacks at each end, and shake the grain briskly backwards and forwards; this process gives the Cochineal a brilliant polish, and though less weight is finally obtained from a given quantity of green Cochineal, the price it commands in the London market compensates for the loss of weight. But the best processes for preparing this polished Cochineal are known only to a few, who keep the secret jealously; the oven is, therefore, still almost universally used for drying.

After the grain is thoroughly dried, it is well sifted in order to free it from a white powder which to the last clings to it; numbers of prickles which have fallen from the leaves have also to be removed. Excellent machines have been invented for this purpose both in England and America. The Cochineal being thus dried and cleaned, it is packed for exportation into bags containing about 150 lbs. each, which are carefully sewn up. This is done by the trader who buys it from the cultivator, the latter rarely exporting the grain on his own account. The results obtained by different growers of Cochineal vary so much, in con-

sequence of the peculiar circumstances to which the crops are exposed in different localities, that it is impossible to fix upon the actual value of an average yield per acre; but it is universally admitted by the land-owners in the Canary Islands, that no other branch of agriculture is so remunerative. The average temperature in the southern part of the Canary Islands is about 80° to 85° Fahrenheit, and it rarely falls at night below 56° or 60°. At Laguna, and at Orotora, and other places in Teneriffe, where Cochineal is cultivated at a height of nearly 2,000 feet above the level of the sea, the climate is temperate. The thermometer rising to 72° or 78° in the summer, and falling at times during winter nights to 45°.

In all these places the cactus thrives, and Cochineal can consequently be reared successfully.

Rain falls in Teneriffe (more plentifully on the high lands than on the coast) from the month of October to April, often in heavy showers, which continue at intervals for two or three days, these are generally followed by two or three weeks of dry weather. The rains are seldom excessive; the winds rarely amount to gales. From May to October the weather is constantly dry. There are no tables of rain-fall during each month to be obtained here.

The following account, showing the amount of the first outlay, and of the annual expenses and profits per acre of a Cochineal plantation, has been given by a grower in the middle lands, of the valley of Orotora, Teneriffe :—

	£	s.	d.
Purchase value of land per acre, ...	50	0	0
Preparation of land and cost of planting and growing cactus for the first year before receiving the Cochineal crop, ...	90	0	0
Bags, baskets, and other utensils, ...	10	0	0
First outlay, ..	150	0	0
Annual Expenses.			
8 boxes of "madres," at 2s. per pound, ..	32	0	0
Wages for planting, gathering, and preparing Cochineal,	30	0	0
12 quintals of guano, at 13s. 4d. per quintal, ..	8	0	0
Digging, weeding, watering, and general expenses, ..	18	0	0
Total, ..	88	0	0
Annual Profits.			
50 lbs. of black "madres,"	8	0	0
8 quintals of silver Cochineal, at 3s. per lb., ..	120	0	0
Total, ..	128	0	0
Net Profit, ..	40	0	0

The average price at which the "madres" can be obtained varies much at different times, falling as low as 9d., and frequently rising to 2s. 6d. and even 3s. per pound.

The management of the insect gives employment to a large number of women; it can almost exclusively be conducted by them. The larger proprietors employ most of their hands during the whole year, so as to command a full number when the labour of the season comes on. The wages of the women in the valley of Orotora is 6*d.* per day, or 3*s.* 6*d.* per week for the best workers. Day laborers receive at the rate of 6*s.* 3*d.* per week for digging and planting, &c., &c. The successful culture of the Cochineal requires experience and patient attention on the part of the grower; he will receive his reward by obtaining a return of from 25 to 30 per cent. upon the capital employed.

II.

In Mexico Cochineal is cultivated in much the same way as in the Canary Islands, Mexico being in fact the native country of the insect. Cactus plants are cultivated by the natives round their huts, and upon the plants the insects attach themselves and rapidly increase in numbers. The season of rearing and gathering lasts about seven months, during which period the insects are gathered three times. After the gathering some of the branches and leaves containing females and their young are preserved under shelter, and on the return of the proper season they are distributed over the plantation. A few females are put into a nest of some downy substance, which is placed on a branch of a cactus plant. The young insects quickly spread themselves out upon the leaves to which they attach themselves. They are gathered and killed by being brushed off with a feather into pans containing boiling water, or by being brushed into baskets and subsequently steamed or heated in an oven. When taken out of the hot water or steamer, the insects, which are now swollen to twice or thrice their natural size, are dried in the sun, and then packed for the market. The different modes of killing and drying the insects cause the various differences in the appearance of commercial cochineal. The usual appearance is of irregularly formed grains, fluted and concave. The best sort seem as if dusted with a white powder, and are of a slate grey colour. This appearance is often imparted artificially by means of powdered talc to deceive the purchaser.

Three kinds of cochineal are recognised in commerce. The finest is known as "Mistic" from La Mistica, the name of the place in Honduras, where the best insects are reared. These are the *grana fina* mentioned above. An inferior variety is known as "wild cochineal," the *grana sylvestris.* The third and least valuable kind is known as "mixed cochineal," being a mixture of the worthless insects of the two first mentioned descriptions.

Cochineal has been several times chemically analysed, but the results are not altogether satisfactory. Cochineal contains—

1. Carmine, which may be called the colouring matter.
2. A peculiar animal matter.
3. A fatty matter composed of stearine, oleine and volatile fatty acids.
4. Saline matters, such as phosphate and carbonate of lime, chloride of potassium, phosphate of potash, and potash combined with organic acids.

The red colouring matter is generally about 50 per cent. of the whole.

Carmine, or the colouring matter of cochineal, may be obtained by macerating finely ground cochineal with ether, which dissolves out the fatty matter, and then dissolving the carmine by the application of hot alcohol and leaving the solution to cool: on evaporating the alcohol, the carmine is deposited as a beautiful red crystalline substance, which dissolves freely in water. *It is affected by the following re-agents,* as under:—

Tannin, ...	Gives no precipitate.
Most acids, ...	Change its colour from a bright to a yellowish red.
Boracic acid, ...	Does not change the colour, but rather reddens it more.
Potash, soda and ammonia,...	Change it to a crimson-violet.
Baryta and strontia,... ...	Produce the same effect.
Lime, ...	Gives a crimson-violet precipitate
Alumina, ...	Combines with it and precipitates it as a beautiful red; but if boiled it passes to violet-red. A little potash, soda, or ammonia added prevents this change and preserves the stability of the red.
Protoxides of tin, ...	Change it to crimson-violet.
Peroxide of tin, ...	Change it to yellowish-red.
Salts of iron, ...	Turn it brown; no precipitate.
Salts of lead, ...	Change it to violet, no precipitate.
Salts of copper, ...	Change it to violet; no precipitate.
Nitrate of mercury,... ...	Gives a scarlet-red precipitate.
Nitrate of silver, ...	Has no action upon it.
Chlorine, ...	Turn it yellow.

As may be supposed, it is next to impossible to judge of the goodness of a cochineal by its physical characters. In order to ascertain its value, we must have recourse to comparative experiments. We are indebted to MM. Robiquet and Anthon for two methods of *determining the quality of cochineals* according to the quantity of carmine they contain. The process of M. Robiquet consists in decolourising equal volumes of decoction of different cochineals by chlorine. By using a gra-

duated tube, the quality of the cochineal is judged of by the quantity of chlorine employed for decolorising the decoction. The process of M. Anthon is founded on the property which the hydrate of alumina possesses of precipitating the carmine from the decoction, so as to decolorise it entirely. The first process, which is very good in the hands of a skilful chemist, does not appear to us to be a convenient method for the consumer. In the first place, it is difficult to procure perfectly identical solutions; in the next place, it is impossible to keep them a long time without alteration. We know that chlorine dissolved in water reacts, even in diffused light, on this liquid, decomposes it, appropriates its elements, and gives rise to some compounds which possess an action quite different from that of the chlorine solution in its primitive state. The second process seems to us to be preferable, as the proof liquor may be kept a long while without alteration. A graduated tube is also used; each division represents one-hundreth of the colouring matter. Thus, the quantity of proof liquor added, exactly represents the quantity in hundreths of colouring matter contained in the decoction of cochineal which has been submitted to examination.

M. Anthon says,—"The colouring matter of cochineal being soluble "in water, I have used this solvent for exhausting the different "kinds which I have submitted to examination in the colorimeter. "I operated in the following manner:—

"I took a grain of each of the cochineals to be tried, dried at 122° "Fah., I submitted them five consecutive times to the action of 200 "grains of distilled water at water-bath heat, each time for an hour; "for every 200 grains of distilled water I added two drops of a "*concentrated solution of acid sulphate of alumina and of potash.* "This addition is necessary to obtain the decoctions of the different "cochineals exactly of the same tint, in order to be able to compare "the intensity of the tints in the colorimeter. Care must be taken "not to add to the water, which serves to extract the coloring mat-"ter from the different cochineals, more than the requisite quantity "of acid sulphate of alumina and solution of potash, because a "stronger dose would precipitate a part of the colouring matter in "*the state of lake.*

"In order to estimate a cochineal in the colorimeter, two solutions, "obtained as described above, are taken; some of these solutions are "introduced into the colorimeter tubes as far as zero of the scale, which "is equivalent to 100 parts of the superior scale; these tubes are "placed in the box, and the tint of the liquids enclosed is compared by "looking at the two tubes through the eye-hole, the box being placed "so that the light falls exactly on the extremity where the tubes are. "If a difference of tint is observed between the two liquors, water is "added to the darkest (which is always that of the cochineal taken "as type) until the tubes appear of the same tint. For diluting the "liquors the same water must always be used which has served to "extract the colouring matter of the cochineals under examination, "otherwise the darkest decoction would pass into violet as water was "added to it to bring back the tint to the same degree of intensity as

"that of the decoction to which it is compared. The number of parts "of liquor which are contained in the tube to which water has been "added is then read off; this number, compared with the volume "of the liquor contained in the other tube, a volume which has not "been changed, and is equal to 100, indicates the relation between "the colouring power and the relative quality of the two cochineals. "And if, for example, 60 parts of water must be added to the liquor "of good cochineal to bring it to the same tint as the other, the "relation of volume of the liquids contained in the tubes will be "in this case as 160 is to 100, and the relative quality of the co- "chineals will be represented by the same relation, since the quality "of the samples tried is in proportion to their colouring power."

Dr. De la Rue has separated the colouring matter from cochineal, which he finds composed of C_{14} H_{14} O_{8}, and has named it carminic acid.

Some of the German chemists, supposing that the plant upon which the insect feeds might be the source of the colouring matter, instituted a series of experiments to determine that point, but without success. The conclusion they came to was, that the animal economy plays a prominent part in the formation of the colouring matter.

Carmine is manufactured extensively in France, and is used for superior red inks, paints and for colouring artificial flowers. It is prepared on the large scale by boiling a quantity of cochineal in water with soda, and then adding to it a little alum, cream of tartar, and the white of eggs, or isinglass, which separates the carmine as a fine flaky precipitate. This precipitate is carefully collected.

There is something in the production of good carmine which is not yet fully understood. It is prepared most successfully in France. It is found that with a coal fire to boil the solution, a smaller quantity of carmine is produced than when a wood fire is employed, and there are many other minor points which show the delicacy of its preparation.

The residue of the carmine, and some portions of the precipitate from the cochineal, when first taken from the boiler, are collected and boiled in water; to this mixture is added a solution of alum and chloride of tin, by which a beautiful red-coloured precipitate or lake is formed. This constitutes the pigment known as "carmine lake."

Appended to this article will be found practical recipes for some cochineal dyes.

We now have to consider the possibility of cultivating cochineal in India on a larger scale than has been hitherto attempted. Numerous experiments have been made at various times, but with only partial success. The insect is found not only in Madras, where it was first noticed, but also in Bengal, the N.-W. Provinces, and the Punjab. In 1848 Dr. Dempster successfully dyed woollen cloths with dye extracted from the insect found on the common prickly pear. The quantity of

lake obtained by him from the native cochineal exceeded that obtained from an equal amount of imported cochineal, and was also of a more brilliant hue. Dr. Dempster laid particular stress on the advantage of cultivating the native insect in preference to importing foreign varieties, and his views were corroborated by Dr. McClelland of the Calcutta Botanical Gardens, who wrote on the subject in 1848. In the same year Dr. Fleming found numerous villagers near Amritsar engaged in gathering Cochineal insects from the hedges of cactus or prickly pear. The cochineal was dried and sold to the Amritsar dyers at one rupee a seer. It appears, however, that the growth of wild cochineal is very irregular, the insects completely destroy the cactus plants wherever they appear, and some time must elapse before the plants can grow again. No returns are available of the quantity of native cochineal produced in India. But large quantities are imported *viâ* Calcutta and Bombay for use in dying silk, as is shown from the following table :—

	Cwt.	Value. Rs.
1875-76, ...	3,541	5,18,410
1876-77, ...	836	1,36,024
1877-78, ...	2,283	3,75,338
1878-79, ...	1,290	2,07,859

The bulk of the cochineal imported into India comes from Great Britain, where it is received from various countries, but chiefly from the Canary Islands.

Dr. Balfour, who has written on the subject, lays stress on the fact that the true Cochineal insect can only be propagated on the *red flowered* prickly pear, and will not grow on the yellow flowered variety or *opuntia*. The red flowered variety is, however, abundant in various parts of India, and there is therefore ample means of rearing the true cochineal insect or the *grana fina* in this country. This is in addition to the facilities which also exist for cultivating the indigenous variety mentioned by Dr. Dempster, who wrote as follows :—

"The wild species can be greatly improved by culture and management. The North-Western Provinces, including the hill districts, present a great variety of soil, climate, elevation, &c., which must tend to modify the character of plants and the nature of the insects which feed upon them. Duly favourable localities have been found already, and others more favourable may be discovered."

Forest officers are particularly well placed for making practical trials in the direction of cultivating cochineal, and there is every reason to believe that the cochineal trade can without difficulty be improved and widely extended. In this way an important source of revenue might be developed and a large trade produced.

Recipes.

Cochineal Crimson.—To every gallon of water used, add about 2 ounces, by measure, of bichloride of tin, allow the sediment to settle, and take the clear solution, and apply heat; when warm, work the goods in it for an hour or more.

Boil in a bag of 2 pounds of cochineal, by suspending it on the surface of the water for half an hour; add this to the proper quantity of water for working the goods, the whole being at hand heat; wring the silk from the spirits, and work it in this cochineal solution for half an hour, then let it steep for several hours, keeping it well under the liquor; and finally, wash well in cold water. If the shade is not blue enough, a little cochineal dissolved in ammonia, may be added to the water; and after working in this for ten minutes, wring out and dry.

Cochineal Pink.—This colour is dyed with less cochineal. About half pound will make a good colour. Different shades of pink, rose, and crimson can be dyed by varying the quantities of stuff used.

Cochineal Scarlet.—Dye a deep orange by annotta, then wash and proceed in the same way as for crimson, passing the material first through the spirits, and then through the cochineal, as stated above.

To make Cochineal Liquor, or Paste.—Put 8 ounces ground cochineal in a bottle, and add to it 8 ounces, by measure, ammonia, and 8 ounces water; let the whole simmer together for a few hours, when the liquor is ready for use.

NOTE ON THE EXPERIMENTAL CULTIVATION OF *PITHECOLOBIUM SAMAN* IN THE HORTICULTURAL GARDENS, LUCKNOW AND SAHARANPUR.

Considering the bad seasons experienced since planting, the

Pithecolobiums planted in the Exotic Plantation at Lucknow have made fairly good progress. They were received from Saharanpur in 1879, and planted during the rains of that year: if raised from seed the previous year, their present age is six years. The highest tree is now 17 feet, with a spread of about 20 feet. Another, which is not so high, has a spread of 30 feet, the girth of the stem, at 3 feet from the ground, is 19 inches. The trees look healthy and flourishing, and one or two have shown a few flowers, but as yet no pods have formed.

The soil in which the trees are growing is a sandy yellow loam of fairly good quality, and the trees were planted in it without any special preparation.

The first winter, after planting, they were severely injured by frost, but later on they threw out new growth; where the shoots were numerous, they were thinned out and a leader formed. In the two following winters the points were again killed, but, as at first, the trees quickly recovered, and now, being strong, they do not appear to suffer from frost.

Both in appearance and habit, this tree greatly resembles Sirrus (*Acacia speciosa*), with perhaps a greater tendency to spread; it will probably equal it as a shade tree, and yield about the same amount of timber. If the pods are freely produced, and prove, as stated, acceptable to cattle, it may, on that score, prove a useful tree.

If protected from frost for the first two years after planting, it will, I think, afterwards succeed with ordinary treatment.

A series of experiments was carried out at Saharanpur in 1879-80 and 1881, with the Rain tree (*Pithecolobium saman*), the ultimate results of which were a failure. No difficulty was experienced in growing the tree during the hot and rainy seasons, but it was found that the temperature of the cold season was too low for it, even when the trees were well protected. There were about fifty trees, from 6 to 15 feet high, planted out in different parts of the Garden at the close of the rains in 1881. The winter of that year was exceptionally cold, and at its close not a single tree survived.

NOTES ON NAGESWAR (*MESUA FERREA*) IN THE GARO HILLS.*

In Assam Nageswar grows in the Brahmaputra and Surma valleys from the plains up to nearly 3,000 feet above the level of the sea, sometimes pure and sometimes mixed with other

* Following our practice of last year, we are publishing the three best essays written by the Students of the Central Forest School, who are now returning to their respective provinces after completing their course of instruction. They will not necessarily appear in the order of merit.—[ED.]

trees, such as Sama (*Artocarpus Chaplasha*), Amari (*Amoora spectabilis*), *Gmelina arborea*, Rata (*Dysoxylom binectariferum*), Ping (*Cynometra polyandra*), Kurta (*Isonandra polyantha*), Cinnamon trees, species of Jambolana, &c

I have studied this tree in the Kamrup and Garo Hills forests, but chiefly in the latter place, and I would therefore, confine my remarks solely to the forest of that district. As implied by its name, the whole of the district is hilly. The hills are generally low and broken, with the exception of the central range, called the Tura range, which stretches from Tura, the civil station of the district, in an easterly direction, to the Someswari river, where it terminates in a precipitous manner. The length of this range is about 40 miles. The slopes are far steeper to the south than to the north. The greatest altitude is 4,602 feet above sea-level. This range divides the district into two portions, clearly distinguished from one another in respect of manners, customs and dialect.

The country is well watered by numerous rivers and streams, of which the Someswari, Krisnai, Dudnoi, Jinari, Kalo and Nitai are the chief. Most of these rivers take their rise in the central range which forms the great watershed of the district, and join the Brahmapútra river. They are all perennial, and are navigable for small boats or canoes during the greater part of the year right up to the foot of the hills.

The climate of the district is semi-tropical. The rains commence regularly from the latter part of May, and last till the middle of October. There are also occasional showers in March. The average annual rainfall at Tura is about 110 inches. The average temperature of the district is about 75°. South-west winds generally prevail in the district.

The rock consists principally of sandstone, gneiss and quartzite, with occasional veins of trap. A grey nummulitic limestone lies along the southern foot of the central range. Claystone and mica schist and also seams of coal are frequently met with.

The whole of the district is covered with jungle, dotted here and there with small Garo villages. The people are wild and barbarous, but have a strong predilection for barter.

There are many beautiful timber trees in the district, including Sál, Nageswar, Tún, Champa, &c. The forests on the Tura range are very extensive, and contain trees of great size and majestic appearance; but the steepness of the hill sides and the distance of the range from good water communication preclude their utilization to a certain extent.

Broadly speaking the forests in the district may be classified as follows:—

(1). *Sál forest.*
(2). Other deciduous forest.
(3). Bamboo forest.
(4). Lower hill forest.

(5). Nageswar forest.
(6). Upper hill forest.

The last three classes of forests occur in the central range, while the bamboo occupies almost all the northern and eastern slopes of the rest of the hills, and sál and deciduous forest the more sunny aspects.

Nageswar forest, the subject of this essay, forms a belt along the slopes of the central range at altitudes ranging from 1,000 to 3,000 feet between the lower hill forests below and the upper hill forests above. The so-called upper hill forests contain oaks, chestnuts, magnolia, yew, &c., while the lower hill forests consist chiefly of evergreen trees and shrubs, including rattans, and form a much denser growth. Nageswar, occupying, as said before, the central portion of the range, grows very thickly at the heads of the three rivers, the Nitai, Bhogai and Someswari. It thrives best in deep and loamy soils, due to the decomposition of granitic rocks, gneiss, &c. There is usually a good covering of vegetable mould, and an undergrowth of evergreen shrubs, but grasses owing to dense shade are absent. Fires rarely, if ever, occur in Nageswar forest. The tree, requiring as it does considerable moisture in the soil, is naturally confined to damp sheltered localities.

The height attainable by the Nageswar in the Garo Hills is about 80 feet, with a clean bole of 30 feet, and the average girth is about 5 feet. The finest trees that I have met with in the district are found at the head of the Simsang river, amongst loose half decomposed gneiss and sandstone rocks in moist shady ravines.

It is a tree of very marked habit, the outer surface of the stem or bole being marked with irregular grooves and indentations, giving it the appearance of having been twisted.

The crown is thick, bushy and pyramidal, especially in young and isolated trees.

The growth is slow, especially in the earlier part of its life of the tree. In two or three years it developes a strong leading shoot which pierces through the leaf canopy over-head with great energy.

The seedlings develop a long strong tap-root, a circumstance which renders their transplanting difficult, but which enables them to offer great resistance to strong winds and drought.

Nageswar is a gregarious tree and sometimes forms dense, almost pure forest. Its associates mostly are evergreen and moisture-loving trees.

Nageswar is evergreen, and the lower and older leaves commence to fall at the end of winter, while a flush of new leaves comes out before March. The young leaves are generally of a pink or copper colour, and the trees in their new foliage can be recognized miles off.

The tree becomes fertile at from 15 to 20 years of age in the forest, but earlier in the open. It begins to flower here in

March, but the seed is not ripe until September. The influence of light and heat is very marked in the case of this tree in respect of the production of seed. Any one who has been in Nageswar forest during the flowering and fruiting season may have remarked that trees standing close together do not flower every year, and when they do flower, they produce very little seed; whereas isolated trees flower and fruit abundantly, and that almost every year. Hence one may say that the flowering and fruiting of Nageswar are in inverse proportion to the density of the forest. The flower is solitary and terminal, and rarely axillary, very sweet-scented, and is used medicinally in Bengal. The seed is very large and germinates readily if sown at once after ripening. It will not keep long on account of the oil it contains. This oil is used in medicine and also for lighting. The seed is collected as soon as it falls, as it is greedily devoured by pigs, porcupines and other animals. There is a good local demand for it, and it is sold at about 2 annas a seer.

That Nageswar coppices freely admits of no doubt, and I have seen a young tree when burnt down throw out strong shoots from the collum. Again, I once tried to kill three young plants, growing in front of a rest house at Kulsi, by cutting them flush with the ground, but as often as they were cut back they threw out new shoots. A tree 15 years old in a garden at Calcutta was felled, and the stool sent up new shoots.

The heartwood of Nageswar is very heavy, hard and durable, and is not eaten by white-ants. It is used generally for house-posts and piles. Being very hard, it is seldom sawn up into planks. The Garos are the only people who trade in Nageswar timber. They form themselves into gangs, the head of each gang taking out a permit from the Forest Officer to cut and export the trees. The wood is brought to a check station, where the royalty is realized on it, and whence it is floated down to market and purchased by Bengali merchants, at rates varying from Rs. 4 to Rs. 15 per log.

DEHRA, }
27th November, 1883. } JOGESWAR SUR.

III. NOTES, QUERIES AND EXTRACTS.

PRICKLY-PEAR AS A PROTECTION FOR SAPLINGS.

Memo. by H. S. THOMAS, Esq., of the Madras Board of Revenue.

IT is not generally known what a cheap and effective forest conservator Cactus can be made.

In tracts covered with the common yellow-flowering Cactus or prickly-pear (*Opuntia*) and even in hedgerows of Cactus, it will be observed that trees and saplings not unfrequently crop out. It may be seen from the very railway windows. The reason is that the Cactus bush, where large enough, effectively protects the seedling from cattle, goats, and men, and trees of tamarind, Margosa, palmyra, &c., are found securely growing out of the middle of a Cactus bush, while all around the country is bare of trees. The Cactus also gives the young seedling shade and a covert from the wind. As the Cactus is itself a superficial soil-feeder, and mainly an air-feeder, it does not choke the young seedling, the roots of which soon strike deeper than the Cactus roots.

The trees now growing everywhere in Cactus are those sown by birds, the wind, and other accident, and are in consequence comparatively few in number; whereas if man recognised that in large areas overrun with Cactus, and abandoned to it as practically irredeemable, the Cactus might still be made his useful servant in this manner, valuable timber and fruit-trees could be grown on a large scale at an infinitesimal cost, and when grown the value of the timber and fruit would lead to the Cactus being cleared away at a profit.

All that is necessary is that Collectors who have any extent of Cactus growth in their districts should for a month before the rains, employ a few men to broadcast tree seeds of sorts in the midst of the Cactus, and then leave them to nature. Rs. 50 from Jungle Conservancy Funds would probably sow a whole *talok*, and Rs. 300 a district.

Almost every district in the Presidency has large areas that might be made to bear timber trees in this manner at an almost nominal outlay.

The areas covered with Cactus are also in the immediate neighbourhood of villages, so that this style of Jungle Conservancy might be fairly carried out from Village Jungle Conservancy Funds, and would eventually benefit the villagers.

I do not advocate that any Cactus should be planted, or, any about to be destroyed, left standing for this purpose; only that where it is existing in spite of us, it should be made the while to serve us in this manner.

I do not wish to leave it unacknowledged that before writing the above I had,—thanks to his kindness,—seen the enclosed paper by Mr. J. Steavenson, Honorary Secretary to the Agri-Horticultural Society of Madras, and that it suggested the leading idea that Cactus might be made a thorough protector of saplings; but I differ from Mr. Steavenson in not advising the planting of Cactus, and in thinking that mature trees do not kill Cactus by their shade.

A little judgment should be used in selecting the seeds to be sown. Where the soil is hard and gravelly or rocky, the following may be taken.—

Margosa or Nim (*Azadirachta indica*)—Tamil, Veppa; Telugu, Veppam.

Tamarind.

Palmyra and the date palms.

Gun-carriage tree (*Albizzia Lebbek*)—Tamil, Vagai; Telugu, Dirisana.

Albizzia amara—Tamil, Wunja; Telugu, Nalla-eenga.

Albizzia odoratissima—Tamil, Karuvaga; Telugu, Shinduga.

Mango.

Guazuma tomentosum—Telugu, Oodrick; where the soil is a little better it is not improbable that Teak (*Tectona grandis*) may be grown in this manner. It is worth a limited trial.

In sandy soil the *Bassia longifolia*—(Tamil, Elippe; Telugu, Ippe) is a useful tree: so is the Casuarina.

But the simple rule is to grow the tree found to flourish naturally in the neighbourhood, and Collectors can doubtless obtain from Forest Officers seeds of timber trees, with memoranda of the soils they affect.

It should be borne in mind that it would be useless to sow the seeds of mere firewood trees, such as the black* and white† thorn, whose value when full grown would be less than the cost of clearing the Cactus to get at them. They can be better grown elsewhere.

Avenue Planting.

Each young tree planted on the side of an up-country road is commonly surrounded by a mud-wall,—a most expensive plan, and one oft-times fatal to the plant. In any case, the wall stops the circulation of air, which is quite as necessary to healthy young growth as the prevention of rocking caused by violent winds. If the plant be small and weak, it is smothered

* *Acacia Arabica* (Tamil, Karuvela; Telugu, Nalla tumma).
† *Acacia leucophloea*, (Tamil, Velvela, Telugu, Tella tumma).

by the soil washed down by the rain and baked hard by the sun, or perhaps drowned by the water collected within the wall. A wall of open stone-work is not so objectionable, except on the score of expense; and nothing could be better than a fence of dead thorns, but for the prize it offers to the village stick-gatherers, and the consequent perpetual restoration it requires ere the tree is, say, four years old, and able to take care of itself.

The Municipal Commissioners of a large town in the Mofussil estimated every tree grown along their road-sides protected by the above methods as having cost Rs. 5 to 6. Had those trees been grown and protected in the manner suggested below, each tree, when old enough to have the fences removed, would probably have cost under 12 annas, or roughly 2 annas for planting and fencing, 6 annas for watching and keeping the guard within bounds, and 4 annas for clearing away and destroying the fence when done with.

Probably one of the greatest curses of Agricultural Southern India is Opuntia, the common yellow-flowering prickly-pear. Large tracts of country are said to have gone out of cultivation, or are not cultivated in consequence of its sturdy growth. Vast sums of money are annually spent by ryots and Local Fund Boards in resisting its encroachments, and perhaps at first sight there is scarcely a subject in the vegetable kingdom so utterly without a really profitable use. True, its fruit is largely eaten by the poor in times of scarcity, and its fleshy blades have been used as fodder; but its common, and perhaps most unprofitable, use is as boundary fence,—a use, for which the constitutional want of foresight of the ordinary native of India renders it singularly unsuitable. The ryot throws the blades into a ridge along the side of his field, sows and reaps his dry crop, and forgets the enemy to which he has deliberately given a lodgment. When he returns to replant for the next season, he finds that every fragment of the prickly-pear has rooted and sent forth shoots, and that his hedge instead of being 3 feet wide is 6, and that in spite of his feeble clippings it means to increase, and that by arithmetical progression.

But even while the prickly-pear devours the arable land, it has a use, and that a great one. It is nature's own bulwark for seedling trees. Into the midst of the great rampart the winds drive the broad, light pods of Albizzia and the drifting seeds of the Cassia, while the birds and beasts add their quota in the shape of the more weighty seeds of Acacia, Cúrkapillay, Ním and Tamarind, which far beyond the reach of cloven foot and biped, germinate and thrive amazingly. Travellers will observe along canal banks and road-side slopes and in village waste places, that in the middle of most clumps of prickly-pear stands and grows a healthy sapling; and it may be stated with little fear of contradiction, that in many and many a village in this Presidency were it not for the prickly-pear there would not exist a single tree.

Often and often the good deeds it has done may be seen long after the plant itself is swept away. The Collector or some other official comes through the village, and is shocked at the rampant unsanitary growth. An edict goes forth; the prickly-pear is doomed, probably not a day too soon; holes are dug and the succulent stems are cut down and returned to the soil from which they sprung, but the trees they sheltered are left standing. Those that got the first start and have made the most of their four or five years of life are safe, but the slender two-year old is soon destroyed. A flock of goats comes by, and every leaf is quickly stripped from the sapling; these are followed by the village dame,—the thrifty housewife who sees not the future, but only what she is pleased to consider a dead stick, without thorns severe enough to keep her off,—and the poor young tree is speedily added to her basket of cow-dung.

Let us utilise the prickly-pear; let us tame, train, and render the savage amenable to discipline, and it will serve us well. Nature itself has proclaimed it to be the very best protection for the young tree. Its thorns bid man and beast stand aloof, while its shelter protects the tender shoots from being knocked to pieces by the rude wind or parched to death by the pitiless sun. Such powers are easy to apply. Let two or three cubic feet of soil be loosened with the pick or crowbar,—never mind the stones, trees like to work their roots in and out amongst loose stones, which also help to keep the soil open and moist,—in each spot in the tope, belt or avenue where a tree is intended to stand; in the centre of each spot plant your little tree, or bury a few seeds of the tree which you see growing in similar soil in the neighbourhood; and over the whole spot for a space, say, 6 to 8 feet in diameter, spread branches of prickly-pear. This being done just before the rains, little (if any) watering will be required; the seeds will germinate and grow rapidly in natural course; or care has been taken so to prop up the young plant as to prevent the wind shaking it too much before it has spread out its own roots in the newly loosened soil, a healthy young tree will soon unfold its leaves above the surrounding spines. The young tree and its guard will grow gaily side by side, the thorns becoming a bush as the plant becomes a sapling. After a year or so as the Cactus spreads, the man in charge of the plantation must go round from day to day with a bill-hook with a long handle, such as is used in England to switch hedges, and lopping off the spreading arms of the prickly-pear, throw them on the top of the mass, of course preventing the central arms from overtopping or interfering with the upward growth of the tree. The result will be, according to soil and situation, in from three to six years, a young tree with a stem of 10 feet to the first branch, too tall and strong to be injured except by lethal weapons. Then the tree's protector has served the purpose for which it was created, and must be destroyed, though in the course of

nature it would gradually die away under the (to it) suffocating shade of its own nursling, for it cannot live without the sun. The Cactus must be cut down, and buried too deep for its sturdy shoots to reach the surface, or in the wet season drowned in the nearest pit full of water, or in the dry weather merely spread out and turned over in the sun till it is too dry to root, and the tree that it nursed will remain while—

> "Heaven sends it happy dew,
> Earth lends its sap anew,
> Gaily to bourgeon and broadly to grow."

THE PROCESS OF EXTRACTING ALOE-FIBRE.

(From Proceedings of Madras Board of Revenue, dated 29th May, 1883).

In the extraction of aloe-fibre great care should be taken as to the method applied. A method has lately been discovered of extracting the fibre in the most economical way, and its adoption may with advantage be made to supersede the present mode of extraction by beating the leaves, and steeping them in stagnant water. The new machine introduced in the colonies of Bourbon and Mauritius is a kind of scraper, which consist of a wheel, as big as a common cart wheel fixed upon a stand, and surmounted throughout its circumference by 14 or 15 scrapers one foot apart from each other, fixed in the wood, and kept firm by means of pegs; and is put in motion by means of a propeller. In front of the wheel, within a carefully-defined space, is a piece of wood against which the scrapers press, and according as the wood is too near or too far, the fibres of the leaves placed upon it, are either cut, or not sufficiently scraped.

In the newest and best form of this machine, the pointed end of the leaf is first scraped, and the leaf moved on till the whole has passed under the scrapers.

Experiment has shown that the method described above is effectual in extracting fibre, without great waste as is found to be in the ordinary mode of extraction by beating the leaves, and leaving them to soak in the stagnant water for a time.

The steeping process, however, is necessary when the threads are intended for making clothes, for this would make the threads softer and stronger.

Aloes afford necessary material for making cords and ropes, and can with advantage be substituted for hemp and flax ropes. This fibre also serves to make up all that is necessary to harness animals of draught and burden.

The fibre is sufficiently good to furnish an article of commerce of the first order, and is destined to acquire in the future a considerable value, especially since the prejudice against white cordage seems to be disappearing. It is to be hoped that im-

portant experiments will be undertaken to ascertain what are the best conditions in which the leaf should be cut, and also whether it is not possible to extract the fibre by mechanical means. Care should also be taken, when preparing the ropes, not to cut the fibres when turning them; this is a delicate operation which should be entrusted to professional rope-makers.

The aloe grows where nothing else will grow, without cultivation, without expense. No injury whatever can be done to it either by drought, inundations, cyclones, or any of the innumerable evils which often prejudicially affect the cultivation of ordinary crops.

As already explained above, the aloe produces at present, in fibre, an average of about 3 per cent. of its weight, whilst with the old apparatus 2 per cent. was hardly realized. The fibre of aloes packed in bales was sold some time back in the London market at an average price of from £30 to £32 per ton, but recent accounts show sales at £38 and £40, or an advance in price of £8 to £10 per ton. These figures prove great stability in the price of the article, and are explained by the following extract from Dr. Forbes Royle's work already mentioned above :—

"It has often been said that that the only means of knowing the value of fibre or of any other produce is the price which it realises in trade. This is very true as regards known articles, but, if a new produce be sent to a market, few persons will buy it, because it requires new machines. I have been told that many years must elapse before a new article can draw the attention of purchasers; this is likely, for it is one of the laws of commerce."

As regards planting, much need not be said. The aloe may be planted in all seasons, and from saplings of one year, or two or even three years old. It is best however to plant from seed. The older the aloes are when transplanted, the sooner the stem is formed. Aloes planted from seed or from saplings of the first year take five years to attain their full development, whilst, if transplanted at a height of from 18 or 20 inches, they are fully developed in three years.

In the Mauritius may be seen growing spontaneously the following species of aloes :—

(1) "Agave americana" (American or blue aloes).
(2) "Agave angustifolia" (aloes with small leaves).
(3) "Fourcroya gigantea" (green aloes).
(4) "Fourcroya gigantea var" (cabbage or Malgache aloes).

The species known in the Mauritius as green aloe came originally from South America and the Antilles.

THE LATE AKA RAID IN DARANG.—We give below some paras. from the *Pioneer* regarding the late Aka raid, which is a piece

of insolence that might have been anticipated considering the circumstances of their treatment by Government.

Every cold weather, these hill-men, fully armed after their own fashion, come down to Tezpur, the district head-quarters, to receive what they call tribute from Government, really a species of blackmail, which is a legacy left us by the old Assam rajas, who used to secure their frontier from raids in this way.

The hill-men are greatly feared by the villagers, as the latter know what treatment to expect from them in case British rule should terminate, and they are not at all assured as to its duration.

During the cold weather the villagers bury all their ornaments and rupees, and supply the hill-men with free quarters in their own villages until the latter are pleased to return to their own country.

This treatment has encouraged the Akas to assume a singularly insolent air, and to form quite a contemptuous idea of the British power, and they will now probably get a lesson which has been only too long delayed.

"The Akas, a tribe inhabiting the sub-Himalayan district to the north of Tezpur, have given no trouble since 1835. But lately some ill-feeling grew up on account of the forest reserve and the restrictions on tapping India-rubber trees in Government forests, which culminated in the recent raid, the real story of which is as follows:—On November the 10th, a party of about 100 Akas made their appearance at the forest office at Balipara, 20 miles north of Tezpur. They behaved quietly at first, and said they wanted to buy rice; but having got hold of some liquor they grew uproarious and went off in the evening, carrying the Forest Ranger and Clerk with them. It was hoped at first that it was only a drunken freak, but the captives have not been returned since, and twelve men who lately went into the hill country with the Lakhidar or Honorary Magistrate to get articles for the Calcutta Exhibition, say that a conference of the tribe took place, at which it was determined to detain the Lakhidar, and to make an expedition to Balipara after the conference. The Lakhidar is still detained. The Chief Commissioner has collected 200 Frontier Police on the frontier, and has sent a message demanding the rendition of the captives and of the ringleaders in their capture, with an apology. The country of the Akas is unsurveyed and little known; but the tribe is only armed with *daos* and arrows."

"The latest news from the Aka country does not tend greatly to the development of the situation; but the Mauzadar, who having been sent up into the hills to collect curiosities for the Exhibition fell into the hands of the tribe, has not yet been surrendered. The raid seems to have been conceived, in a rollicking, jovial spirit not unworthy of Lever's Irishmen. We read that the unfortunate Forest Clerk who was carried off was first compelled to treat the party to liquor, and afterwards pressed to accompany them to the hills. When he still excused himself, his visitors seized the unfortunate Babu and

slung him to a bamboo, hands and feet tied, as the account says, "like a deer." Unless the Babu was an indifferent specimen of his race, we may imagine that his captors must have been very soon tired of carrying him."

"Meantime it may be worth while to explain who the Akas are. They belong to a race which, under various names, peoples the eastern line of the Himalayas, from the confines of Bhutan to those of the Shan States and China. Of the various tribes, connected by intimate linguistic and ethnological affinities, into which this race is divided, the Akas are the westernmost, being in fact next neighbours to Bhutan. How far back they go in the mountains, *i.e.*, how far northwards the tribe extends, is a question upon which nobody can venture an opinion, but the probability is that intercourse with the plains is restricted to the inhabitants of a comparatively small extent of country. The Akas are Mongolian in feature, and rather short of stature, solidly built, and with a complexion which looks ruddy beside the darker faces of the plains. Their arms are the spear, the dao, and the bow. They have no organisation for military purposes, each village being an independent community under its own chief, nor have they ever shown a tendency to aggression. Their religious belief is of the vague and primitive character common to all the cognate tribes. They worship the spirits of their departed ancestors, and the demons supposed to inhabit mountains and rivers. These have to be propitiated, lest they should do one a mischief, but of any definite notions regarding a future state the Akas seem to be utterly destitute. They are not on bad terms with their immediate neighbours in the plains, nor do the villagers profess to be afraid of them. It seems probable that some dispute about rubber-tapping may really be at the bottom of the present business, and the Akas may have carried off the two forest officials not so much by way of revenge as with the intention of compelling the superior authorities to listen to their supposed grievances."

"The Aka affair has suddenly assumed a serious complexion. We learn by telegraph from Assam that messengers have returned from the Akas bringing insolent letters in reply to the Chief Commissioner, and demanding the surrender of the entire forest reserve, about 100 square miles of land, before they surrender their captives. The two Forest Clerks are still alive, but the Lakhidar died after five days' illness. The Government have sanctioned a military expedition to bring the tribe to reason, and it will consist of the 43rd (Assam) Native Infantry, part of the 12th Native Infantry, and some Sappers with mortars, under Brigadier-General Hill. The military are being rapidly pushed forward, and every effort will be made to strike quickly, in order to save the lives of the captives."—*Pioneer.*
